

**TARGETED BROWNFIELDS ASSESSEMENT (TBA) PHASE III  
CLEANUP PLAN/COST ESTIMATE, FINTUBE SITE, 150 & 186  
NORTH LANSING, CITY OF TULSA, TULSA COUNTY,  
OKLAHOMA**

**FINAL**

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**Prepared for:**

**Tulsa Industrial Authority  
175 East 2<sup>nd</sup> Street, 15<sup>th</sup> Floor  
Tulsa, Oklahoma 74103**



**September 8, 2011**

**Prepared under:**

**Contract No. W912BV-10-D-2005; Task Order 0002**

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**Prepared for:**



**U.S. Army Corps of Engineers, Tulsa District  
1645 South 101<sup>st</sup> East Avenue  
Tulsa, OK 74128-4609**

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## TABLE OF CONTENTS

Acronyms and Abbreviations .....	v
1. Introduction.....	1-1
1.1 Site Background.....	1-1
1.2 Site-specific Environmental Setting .....	1-1
2. Risk-Based Cleanup Levels .....	2-1
3. Cleanup Alternatives.....	3-1
3.1 Asbestos .....	3-1
3.1.1 Alternative 1 – No Action.....	3-1
3.1.2 Alternative 2 – Complete Asbestos Abatement.....	3-1
3.2 Lead-based Paint.....	3-1
3.2.1 Alternative 1 – No Action.....	3-1
3.2.2 Alternative 2 – Paint Stabilization .....	3-1
3.2.3 Alternative 3 – Complete Lead-based Paint Abatement.....	3-2
3.3 Contaminated Soil and Groundwater.....	3-2
3.3.1 Alternative 1 – No Action.....	3-2
3.3.2 Alternative 2 – Limited Soil Excavation and Long-term Groundwater Monitoring .....	3-2
3.3.3 Alternative 3 – Moderate Soil Excavation, Limited In Situ Groundwater Treatment and Metals Background Assessment.....	3-5
3.3.4 Alternative 4 – Complete Soil Excavation and In Situ Groundwater Treatment .....	3-8
4. Recommendations.....	4-1
5. References.....	5-1

## Appendices

A	Contaminant Exceedance Tables for Surface Soils, Subsurface Soils, and Groundwater
B	Cost Estimate

## TABLE OF CONTENTS (cont.)

### Figures

1-1	Topographic Map.....	1-3
1-2	Site Layout Map.....	1-4
3-1	Sample Location Map.....	3-11

### Tables

2-1	Media Specific Risk-based Cleanup Levels .....	2-1
3-1	Alternative 2 Cost Breakdown.....	3-3
3-2	Surface Soil Sampling Locations to be Included in Surface Soils Excavation.....	3-4
3-3	Alternative 3 Cost Breakdown.....	3-5
3-4	Surface Soil Sampling Locations to be Included in Surface Soils Excavation.....	3-6
3-5	Alternative 4 Cost Breakdown.....	3-8
3-6	Surface Soil Sampling Locations to be Included in Surface Soils Excavation.....	3-9

## ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
ALL	ALL Consulting
bgs	below ground surface
CUL	cleanup levels
CFR	Code of Federal Regulations
DPT	direct push technologies
ESA	Environmental Site Assessment
ft <sup>2</sup>	square feet
HAL	Health Advisory Level
ISCO	in situ chemical oxidation
LBP	lead-based paint
mg/cm <sup>2</sup>	milligrams per square centimeter
mg/kg	milligrams per kilogram
No.	number
NRCS	Natural Resources Conservation Service
ODEQ	Oklahoma Department of Environmental Quality
OSHA	Occupational Safety and Health Administration
PAH	polyaromatic hydrocarbons
PCB	polychlorinated biphenyl
RACM	Regulated Asbestos-Containing Material
SAIC	Science Applications International Corporation
TBA	Targeted Brownfields Assessment
TDA	Tulsa Development Authority
TPH	total petroleum hydrocarbon

## **ACRONYMS AND ABBREVIATIONS (cont.)**

USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
XRF	x-ray fluorescence

# **1. INTRODUCTION**

The U.S. Army Corps of Engineers (USACE)-Tulsa District contracted Science Applications International Corporation under Contract No. W912BV-10-D-2005, Task Order Number (No.). 0002, to prepare a Phase III Cleanup Plan and Cost Estimate for the Fintube Targeted Brownfields Assessment (TBA) Site located in Tulsa, Tulsa County, Oklahoma. The United States Environmental Protection Agency (EPA) Region 6 Brownfields Team tasked USACE-Tulsa District to execute the Environmental Site Assessment (ESA).

The purpose of the Phase III Cleanup Plan is to develop conceptual remediation alternatives for soil and groundwater contamination, as well as regulated materials (asbestos and lead-based paint) that were identified in the Phase II ESA (ALL Consulting 2010). The end users for this Cleanup Plan are the Tulsa Industrial Authority and the Tulsa Development Authority (TDA).

## **1.1 SITE BACKGROUND**

The subject property, henceforth referred to as the “Site,” is located northeast of downtown Tulsa, Tulsa County, Oklahoma, within an area consisting of industrial, commercial, and residential properties. The Site is bounded on the west by a railroad easement; on the east by N. Lansing Ave. and Highway 75; on the north by Lee Supply Co.; and on the south by E. Archer St. and Highway 244. Figure 1-1 provides a topographic map of the site and surrounding area. Access is available to the Site via N. Lansing Ave. to the east. The Site has two building complexes: The Evans Building Complex and the Fintube Building Complex. This Phase III Cleanup Plan includes both of the complexes as part of the overall property addressed by the TBA. The Evans Building Complex consists of three north-south oriented buildings to the north and two east-west oriented buildings to the south. The Fintube Building Complex, consists of four buildings oriented north-south and one smaller building to the southeast that is oriented east-west. An empty, 20’x20’, open faced, metal shed is located in the far northwest corner of the Site. Figure 1-2 presents the layout of the building complexes at the site. The latitude and longitude coordinates for the Site are 36.1629; (36° 9’ 46.4”N) and -95.9813; (95° 58’ 52.7” W) (NAD83/WGS84).

The Evans Building Complex was formerly a steel manufacturing facility that contained a foundry on the northern end. The vacant lot located east of the Evans Building Complex was formerly used as a paper recycling facility. The Fintube Building Complex was formerly used as a metal manufacturing facility and a producer of heat exchangers that consisted of a concrete reservoir, a forge, and welding and fabrication shops. The vacant lot east of the Fintube Building Complex was formerly a residential area.

## **1.2 SITE-SPECIFIC ENVIRONMENTAL SETTING**

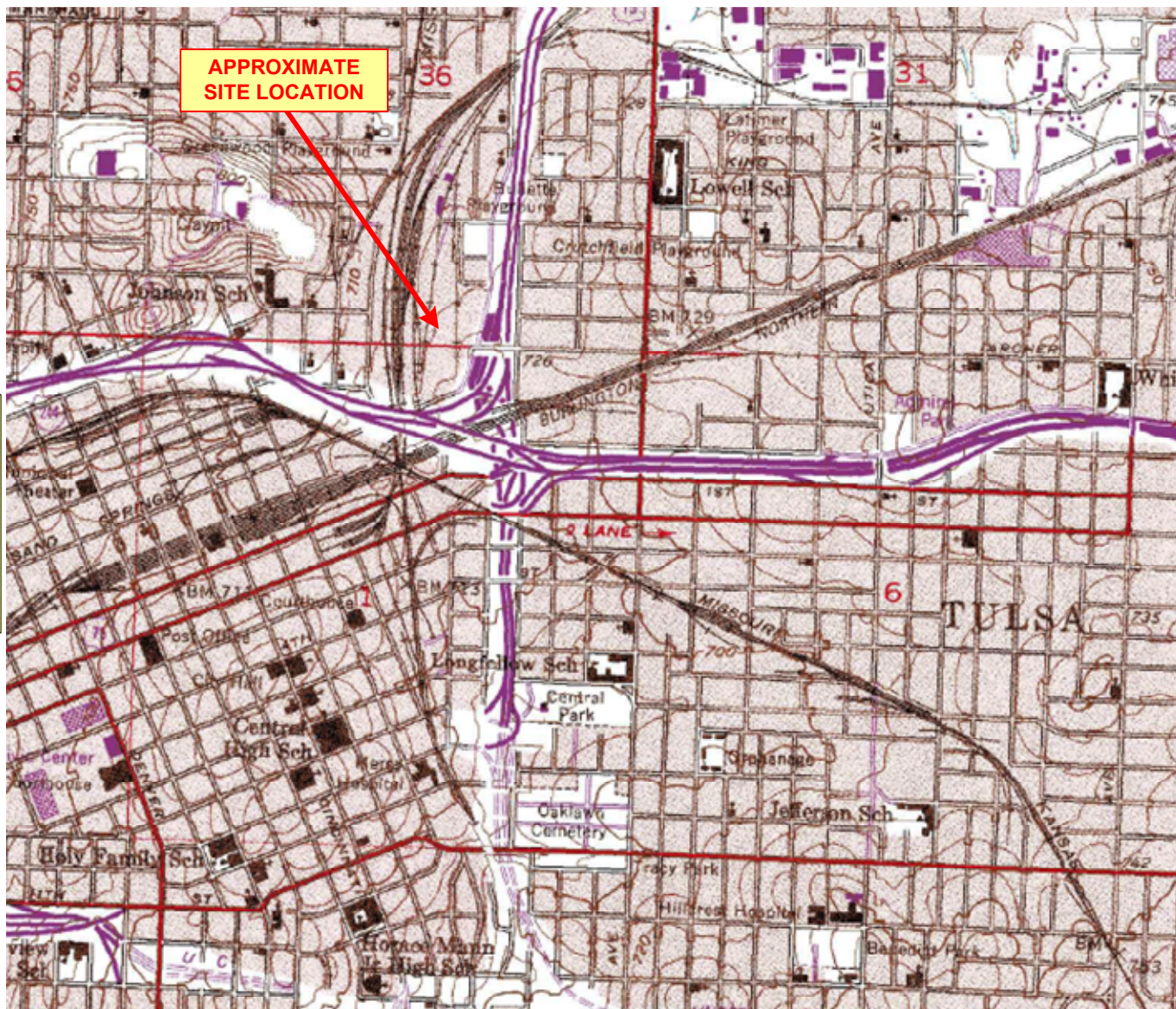
The Geologic Map of Oklahoma shows the geologic unit underlying subject area to consist of the Upper Pennsylvanian-age Seminole Formation, comprised mainly of shale with interbedded siltstone and sandstone. The Vamoosa Formation is a member of the

Vamoosa-Ada aquifer of east-central Oklahoma, an important source of water underlying parts of Osage, Pawnee, Payne, Creek, Lincoln, Okfuskee, and Seminole Counties. The aquifer consists of very fine-grained sandstone, siltstone, shale, and conglomerate interbedded with very thin limestones.

According to the United States Department of Agriculture - Natural Resources Conservation Service (NRCS) Soil Map, the soil at the Site consists mostly of Urban Land (NRCS 2000). The Urban Land at the Site is the result of intermingling native soil with fill material introduced during the prior development of Site and surrounding properties, which makes it impractical to distinguish the native soil types.

Groundwater was encountered in soil borings at depths of approximately 4 to 15 feet below ground surface (bgs). The Phase II ESA did not establish a groundwater profile of the Site. Therefore, groundwater elevation and flow direction was not determined.

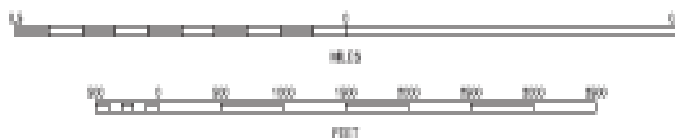
TOWNSHIP 20 NORTH



APPROXIMATE  
SITE LOCATION

RANGE 12 EAST

TARGET QUAD  
NAME: Tulsa, OK  
MAP YEAR: 1979  
SERIES: 7.5  
SCALE: 1:24,000



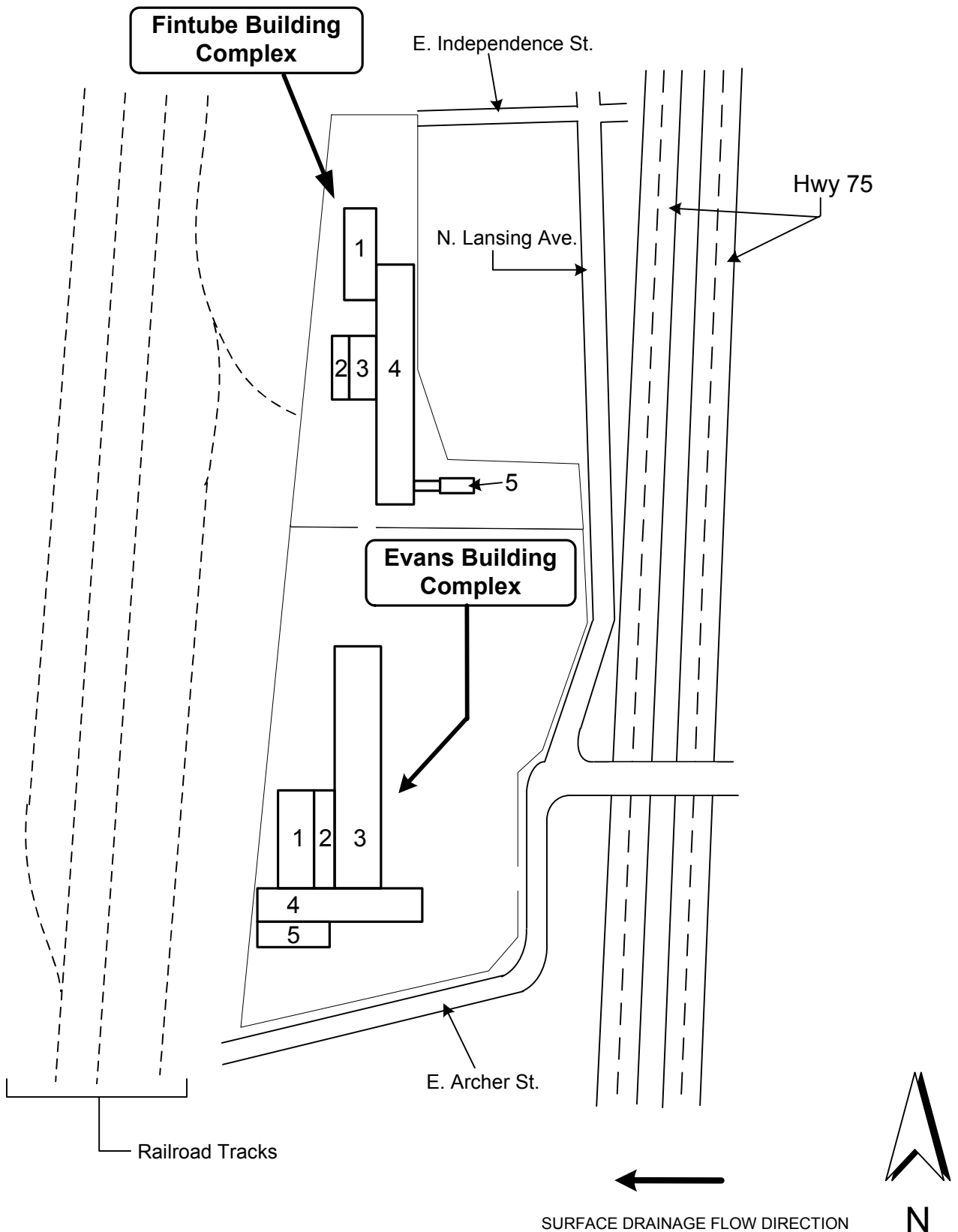
SITE NAME: FINTUBE TBA  
ADDRESS: 186 N. LANSING ST.  
TULSA, OK 74120  
LAT/LONG: 36.1697/-95.9844



## TOPOGRAPHIC MAP

FINTUBE TBA  
TULSA, OKLAHOMA

SCALE: 1:24000	DATE: 05/20/2010	FIGURE NO. Figure 1-1
APPROVED BY: CBM	DRAWN BY: NDA	PROJECT NO. 1303.RPT.00



SITE LAYOUT MAP		
FINTUBE TBA TULSA, OKLAHOMA		
SCALE: AS SHOWN	DATE: 05/20/2010	FIGURE NO. Figure 1-2
APPROVED BY: CBM	DRAWN BY: NDA	PROJECT NO. 1303.RPT.00

## 2. RISK-BASED CLEANUP LEVELS

The contaminant screening levels presented in the Phase II ESA Report were used in this Cleanup Plan as risk-based cleanup levels. The sources of these values are EPA risk screening tables for individual chemical species except for naphthalene, chloroform, and Arochlor1260, and Oklahoma Department of Environmental Quality (ODEQ) Tier 2(a) simple site-specific risk-based values for the total petroleum hydrocarbon (TPH) contaminants for industrial use. Because a site-specific human health risk assessment was not included in our scope, the soils cleanup levels (CULs) for polyaromatic hydrocarbons (PAHs) and Arochlors are derived from the USEPA Regional Screening Levels for Industrial Receptors. All of the inorganic CULs in groundwater are derived from the MCL in the *Safe Drinking Water Act* for that contaminant and are not differentiated based upon industrial or residential receptors.

The groundwater cleanup standard for naphthalene is based upon a USEPA Health Advisory Level (USEPA 2011). ODEQ has no standard or guidance on a CUL for naphthalene in groundwater without a site-specific risk assessment. Because the scope of this project did not include the determination of a site-specific risk assessment, the CUL was based on the USEPA Health Advisory Level (industrial) for naphthalene. Although, several states throughout the nation do have groundwater CULs for naphthalene. The precedence established by the Wyoming UST program when matched with the HAL provided a sound justification for the CUL presented in the Cleanup Plan. These values are summarized in Table 2-1. Tier 2(b) site-specific cleanup levels have not been calculated for this Cleanup Plan.

**Table 2-1**  
**Media Specific Risk-based Cleanup Levels**

Chemical	Soil Cleanup Standard (mg/kg)	Groundwater Cleanup Standard (µg/L)
<b>Hydrocarbons</b>		
TPH (>C12-C28)	2,500	NCE
TPH (>C28-C35)	5,000	NCE
Naphthalene	NCE	700*
<b>Chlorinated Hydrocarbons</b>		
Chloroform	NCE	70**
1,2,4-Trichlorobenzene	NCE	70
µg/L    micrograms per liter mg/kg   milligrams per kilogram NCE    no cleanup level provided because there were no contaminant exceedances Sources : USEPA Regional Screening Levels, vers 2009; ODEQ Risk Based Cleanup Levels (TPH); USEPA Maximum Contaminant Levels (MCLs) from the <i>Safe Drinking Water Act</i> (SWDA) *        Naphthalene has no MCL however USEPA has published a health advisory level as a guideline. This has been used by some states (e.g., Wyoming) for a groundwater cleanup level in the UST program. **        Chloroform value is a Maximum Contaminant Level Goal (MCLG) under the SDWA - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals. ***      Polychlorinated biphenyls (PCB) are addressed in the USEPA Health Advisory Levels at a combined level. Individual Arochlors are not addressed		

**Table 2-1  
Media Specific Risk-based Cleanup Levels (cont.)**

Chemical	Soil Cleanup Standard (mg/kg)	Groundwater Cleanup Standard (µg/L)
<b>Polychlorinated Biphenyl</b>		
Arochlor 1248	0.74	NCE
Arochlor 1254	0.74	NCE
Arochlor 1260	0.74	10***
<b>Polyaromatic Hydrocarbons</b>		
Benzo(a)anthracene	2.1	NCE
Benzo(a)pyrene	0.21	NCE
Benzo(b)fluoranthene	2.1	NCE
Dibenzo(a,h)anthracene	0.21	NCE
Indeno(1,2,3-c,d)pyrene	2.1	NCE
<b>Metals</b>		
Arsenic	1.6	10
Beryllium	NCE	4
Cadmium	NCE	5
Chromium	NCE	100
Copper	NCE	1,300
Lead	800	15
Mercury	NCE	2
Nickel	NCE	730
Thallium	NCE	2
Zinc	NCE	11,000
µg/L    micrograms per liter mg/kg   milligrams per kilogram NCE    no cleanup level provided because there were no contaminant exceedances Sources : USEPA Regional Screening Levels, vers 2009; ODEQ Risk Based Cleanup Levels (TPH); USEPA Maximum Contaminant Levels (MCLs) from the <i>Safe Drinking Water Act</i> (SDWA) *    Naphthalene has no MCL however USEPA has published a health advisory level as a guideline. This has been used by some states (e.g., Wyoming) for a groundwater cleanup level in the UST program. **    Chloroform value is a Maximum Contaminant Level Goal (MCLG) under the SDWA - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals. ***    Polychlorinated biphenyls (PCB) are addressed in the USEPA Health Advisory Levels at a combined level. Individual Arochlors are not addressed		

### **3. CLEANUP ALTERNATIVES**

#### **3.1 ASBESTOS**

The alternatives listed below were considered for management of asbestos identified at the Fintube site. No Category I or Category II non-friable asbestos materials were identified at the site, however asbestos identified as Regulated Asbestos-Containing Material (RACM) was identified in the locker room area of the Fintube complex and in the main warehouse of the Evans complex (Phase II ESA, Appendix F, June 2010). The TDA intends to redevelop the site as a multimodal Tulsa transportation facility and therefore expects both the Fintube and Evans Buildings will remain in place.

##### **3.1.1 Alternative 1 – No Action**

The No Action Alternative assumes that no action is taken and no costs are incurred. This alternative is ineffective in controlling the potential hazards at the site posed by asbestos identified in the Phase II ESA report.

##### **3.1.2 Alternative 2 – Complete Asbestos Abatement**

This alternative includes complete abatement of all RACM identified in both the Fintube and Evans complexes, since the buildings are expected to be renovated for use by the Tulsa transportation agency. This abatement will need to be conducted in accordance with Occupational Safety and Health Administration (OSHA) 29 *Code of Federal Regulations* (CFR) 1926.1101, USEPA 40 CFR 61, Subpart M, and Oklahoma Department of Labor, Abatement of Friable Asbestos Materials rules. The estimated cost for this abatement is \$8,325 (Phase II ESA, Appendix F, June 2010).

#### **3.2 LEAD-BASED PAINT**

The alternatives listed below were considered for management of lead-based paint (LBP) identified at the Fintube site. LBP was identified on exterior walls and sliding doors of the main building and on iron I-beams and stairs in interior buildings at the Fintube complex. LBP was identified on an interior brick wall, interior I-beams, a concrete stem wall and on stairs at the Evans complex (Phase II ESA, Appendix G, June 2010). The TDA intends to redevelop the site as a multimodal Tulsa transportation facility and therefore expects both the Fintube and Evans Buildings will remain in place.

##### **3.2.1 Alternative 1 – No Action**

The No Action Alternative assumes that no action is taken and no costs are incurred. This alternative is ineffective in controlling the potential hazards at the site posed by the contaminated soil and groundwater.

##### **3.2.2 Alternative 2 – Paint Stabilization**

This alternative includes paint stabilization (repainting), since the buildings are expected to be renovated for use by the Tulsa transportation agency. All painted surfaces identified as containing lead, at levels both above and below the USEPA threshold of 1.0 milligrams per square centimeter (mg/cm<sup>2</sup>) by x-ray fluorescence (XRF) or

5,000 mg/kg (lab analysis of paint chip sample) are recommended for repainting. The estimated cost for this alternative is \$207,000 (Phase II ESA, Appendix G, June 2010).

### **3.2.3 Alternative 3 – Complete Lead-based Paint Abatement**

This alternative includes complete abatement of LBP (water blasting or wet scraping), since the buildings are expected to be renovated for use by the Tulsa transportation agency. All painted surfaces identified as containing lead at levels both above the USEPA threshold of 1.0 mg/cm<sup>2</sup> (XRF) or 5,000 mg/kg (lab analysis of paint chip sample) are recommended for abatement. This abatement will need to be conducted in accordance with OSHA 29 CFR 1926.62. The estimated cost for this alternative is \$108,500 (Phase II ESA, Appendix G, June 2010).

## **3.3 CONTAMINATED SOIL AND GROUNDWATER**

The alternatives listed in the following subsections were considered for management of the contaminated soil and groundwater at the site. The locations referenced in the text for soil and groundwater cleanup are based upon the sampling locations from the Phase II ESA. Tables of screening level exceedances in surface soil, subsurface soil, and groundwater from the Phase II ESA Report are included in Appendix A. These sampling locations are presented in Figure 3-1.

All alternatives described are consistent with the entire Fintube site remaining as an industrial use property. Additionally, the TDA intends to redevelop the site as a multimodal Tulsa transportation facility and therefore expects both the Fintube and Evans Buildings will remain in place.

### **3.3.1 Alternative 1 – No Action**

The No Action Alternative assumes that no action is taken and no costs are incurred. This alternative is ineffective in controlling the potential hazards at the site posed by the contaminated soil and groundwater.

### **3.3.2 Alternative 2 – Limited Soil Excavation and Long-term Groundwater Monitoring**

This alternative includes excavation of all contaminated surface soils except that which is contaminated at low levels with polyaromatic hydrocarbons (PAH), limited excavation in the immediate area of each subsurface soil boring that exhibits contamination above the cleanup criteria, and long-term monitoring of contaminated groundwater. Table 3-1 provides a summary of the costs for this alternative. Cost details are presented in Appendix B.

**Table 3-1**  
**Alternative 2 Cost Breakdown**

Item	Cost
<b>Capital Cost</b>	
Surface Soil Remediation	\$997,311
Subsurface Soil Remediation	\$51,211
Groundwater Remediation	\$57,903
<b>Capital Cost Subtotal</b>	<b>\$1,106,425</b>
<b>Operations and Maintenance Cost</b>	
Groundwater Monitoring	\$563,605
<b>Total Cost</b>	<b>\$1,670,030</b>

### **Surface Soils**

For this alternative, all surface soils identified in the Phase II ESA as having contamination present above the cleanup levels will be excavated and disposed off-site, except for those soils where PAHs are the only contaminant identified by the Phase II sampling. With regards to arsenic, only those surface soils locations with arsenic detected above the maximum background concentration of 32 mg/kg will be included in the excavation extent. Soil samples will be collected and submitted for several geotechnical analyses to support development of site-specific risk based cleanup levels for the PAHs, with the intended outcome being that the PAH only contaminated soils will not require excavation and disposal in the final analysis. Estimation of the lateral extent of surface soils to be excavated in the areas exterior to buildings at the site is established by pre-excavation soil sampling using four surface soil samples around each exterior location. For this estimate, it is assumed that the extent will be limited to 20 feet from each exterior surface soil location requiring excavation for contamination. Table 3-2 presents the specific locations to be included in the excavation extent. The identified area of contaminated surface soils will be excavated to a depth of 1.0 foot. These soils will be excavated across the site by conventional means, including inside much of the Evans Building Complex, and disposed at a landfill that accepts contaminated non-hazardous soils in the local area. A significant portion of the flooring in the Evans Building Complex is reportedly wood brick, while in the remainder of interior areas it is assumed to be concrete. These materials will be demolished and removed to access the contaminated surface soils. Confirmation sampling of the floor of the excavation will be performed at a rate of one sample per every 5,000 square feet (ft<sup>2</sup>). Each confirmation sample will be analyzed for either PAHs, TPH, polychlorinated biphenyls (PCB), and/or metals according to the contamination present in that particular area as defined by the Phase II analytical results. The exterior excavated areas will be backfilled with clean soil, while the Evans Building Complex areas will not be backfilled, but rather left for TDA to construct a building slab as desired for future building use.

**Table 3-2**  
**Surface Soil Sampling Locations to be Included in**  
**Surface Soils Excavation**

Exterior Areas	Fintube Building Complex	Evans Building Complex
SSC12, SB04, SSD07, SSD15, SSE07, SB05	SSD04, SSD05	SSC14, SSD10, SSD11, SSD12, SSD13, SSD14, SSE12, SSE13, SSE14, SSF14

### **Subsurface Soils**

For this alternative, contaminated soils in the immediate vicinity of soil borings SB01 and SB04 will be excavated down to the water table and disposed off-site. Soils will be excavated laterally to 10 feet away from each of these soil borings, with this limited extent established by pre-excavation soil sampling using four soil borings around each location. The water table is present at approximately 4 feet bgs at SB01 and at approximately 3 feet bgs at SB04. In the case of both of these soil borings, the contaminated soil sample was retrieved from below the apparent water table, however soil excavations to the water table will still be performed under the supposition that the entire soil column is contaminated due to an original release occurring at the surface. The contaminated saturated soils will be addressed by in situ treatment of the groundwater described below. Confirmation sampling of the limits of the excavation will be accomplished with one floor sample and one sample from each excavation sidewall; confirmation soil samples associated with the SB01 excavation will be analyzed for PAHs while samples associated with the SB04 excavation will be analyzed for PCBs. Each of these excavations will be backfilled with clean soils.

### **Groundwater**

For this alternative, management of groundwater will include installation of six new permanent monitoring wells at the locations SB01, SB02, SB04, SB05, SB06, and SB09 and long-term monitoring of the groundwater. Groundwater samples will be collected from the six wells on an annual basis and samples analyzed for PAHs, volatile organic compounds (VOC), metals, and PCBs, over a duration of 30 years.

### **Institutional Controls**

Institutional controls will be necessary for this alternative because contamination above residential standards will remain in place after remediation is completed. Excavation of surface and subsurface soils to industrial standards means that soils above residential standards will remain at the site. Specifically, a record will need to be added to the property deed by the land owner/developer to note that chemical contamination has been left in place at the site. Additionally, fencing will need to be maintained around the site to exclude access by unauthorized personnel, in order to protect the landowner from potential liability of persons coming into contact with the surface soils that are contaminated. In this alternative, contaminated groundwater will also remain at the site. Therefore, the property deed will also need to be modified to contain a restriction that groundwater wells cannot be constructed for recovery and use of groundwater from the

surficial aquifer. Also, soils identified for disposal created by any construction or other soil intrusive activities on the site must be disposed at a landfill that can accept soils contaminated with hazardous chemicals at low levels. This process will need to be enforced by the site manager, property manager, or owner.

### **Evaluation**

This alternative is expected to be the least protective alternative, due to the limited amount of soil removed by excavation and the lack of active groundwater treatment. However, this alternative also has the highest economic feasibility (low cost to implement) for the same reason. This alternative is expected to be technically feasible to implement. There is programmatic risk, as well as additional project execution time, associated with establishing higher soil cleanup levels for PAHs and obtaining regulatory acceptance of long-term monitoring for groundwater, and so the reliability in controlling site soil and groundwater contamination is questionable. There is some risk remaining with implementation of this alternative related to lack of knowledge of the groundwater flow direction.

#### **3.3.3 Alternative 3 – Moderate Soil Excavation, Limited In Situ Groundwater Treatment and Metals Background Assessment**

This alternative includes excavation of all surface soils contaminated with PAHs, TPHs, PCBs, arsenic, and lead, limited excavation in the immediate area of each subsurface soil boring that exhibits contamination above respective cleanup criteria, in situ treatment of VOC-contaminated groundwater, and assessment of groundwater metals contamination by comparison to appropriate metals background concentrations in groundwater. Table 3-3 provides a summary of the costs for this alternative. Cost details are presented in Appendix B.

**Table 3-3  
Alternative 3 Cost Breakdown**

<b>Item</b>	<b>Cost</b>
<b>Capital Cost</b>	
Surface Soil Remediation	\$1,098,487
Subsurface Soil Remediation	\$47,857
Groundwater Remediation	\$102,317
<b>Capital Cost Subtotal</b>	<b>\$1,248,661</b>
<b>Operations and Maintenance Cost</b>	
Groundwater Monitoring	\$53,405
<b>Total Cost</b>	<b>\$1,302,066</b>

### **Surface Soils**

For this alternative, all surface soils identified in the Phase II ESA as having contamination present above the cleanup levels will be excavated and disposed off-site. With regards to arsenic, only those surface soils locations with arsenic detected above the

maximum background concentration of 32 mg/kg will be included in the excavation extent. Estimation of the lateral extent of surface soils to be excavated in the areas exterior to buildings at the site is established by pre-excavation soil sampling using four surface soil samples around each exterior location. For this estimate, it is assumed that the extent will be limited to 20 feet from each exterior surface soil location requiring excavation for contamination. Table 3-4 presents the specific locations to be included in the excavation extent. The identified area of contaminated surface soils will be excavated to a depth of 1.0 foot. These soils will be excavated across the site by conventional means, including inside much of the Evans Building Complex, and disposed at a landfill that accepts contaminated non-hazardous soils in the local area. A significant portion of the flooring in the Evans Building Complex is reportedly wood brick, while in the remainder of interior areas it is assumed to be concrete. These materials will be demolished and removed to access the contaminated surface soils. Confirmation sampling of the floor of the excavation will be performed at a rate of one sample per every 5,000 ft<sup>2</sup>. Each confirmation sample will be analyzed for either PAHs, TPH, PCBs, and/or metals according to the contamination present in that particular area as defined by the Phase II analytical results. The exterior excavated areas will be backfilled with clean soil, while the Evans Building Complex areas will not be backfilled, but rather left for TDA to construct a building slab as desired for future building use.

**Table 3-4**  
**Surface Soil Sampling Locations to be Included in**  
**Surface Soils Excavation**

Exterior Areas	Fintube Building Complex	Evans Building Complex
SSA01, SB02, SSA03, SB06, SSB05, SSB08, SSC01, SSC03, SSC05, SSC12, SB04, SB01, SSD07, SSD15, SSE06, SSE07, SB05, SSE11, SSE16	SSD04, SSD05	SSC14, SSD10, SSD11, SSD12, SSD13, SSD14, SSE12, SSE13, SSE14, SSF14

### **Subsurface Soils**

For this alternative, contaminated soils in the immediate vicinity of soil borings SB01 and SB04 will be excavated down to the water table and disposed off-site. Soils will be excavated laterally to 10 feet away from each of these soil borings, with this limited extent established by pre-excavation soil sampling using four soil borings around each location. The water table is present at approximately 4 feet bgs at SB01 and at approximately 3 feet bgs at SB04. In the case of both of these soil borings, the contaminated soil sample was retrieved from below the apparent water table, however soil excavations to the water table will still be performed under the supposition that the entire soil column is contaminated due to an original release occurring at the surface. The contaminated saturated soils will be addressed by in situ treatment of the groundwater described below. Confirmation sampling of the limits of the excavation will be accomplished with one floor sample and one sample from each excavation sidewall; confirmation soil samples associated with the SB01 excavation will be analyzed for

PAHs while samples associated with the SB04 excavation will be analyzed for PCBs. Each of these excavations will be backfilled with clean soils.

### **Groundwater**

The monitoring wells used for retrieval of groundwater samples in the Phase II investigation were temporary wells that were not developed at time of installation, nor purged at time of sampling. As well, whether the groundwater samples collected for metals analysis were filtered at the analytical laboratory has not yet been verified. Therefore, the detection of numerous metals above regional screening levels at SB01, SB02, and SB09 may be attributed to metals adsorbed to soil particulate surfaces. Therefore, management of groundwater will include installation of six new permanent monitoring wells at the locations SB01, SB02, SB04, SB05, SB06, and SB09, development and sampling of these wells with filtration for the samples going to metals analysis. The results from this metals sampling will then be compared to background metals groundwater data presumably available from USGS or Oklahoma water resources. The intended result is no further groundwater sampling requirement for metals analysis after the initial sampling event. Additionally, this alternative includes in situ spot treatment of VOC contamination in groundwater at locations SB01 (treat PAHs identified by soil sample), and SB04 (1,2,4-trichlorobenzene). This treatment will utilize in situ chemical oxidation (ISCO) to quickly degrade VOC contamination, and will be implemented by a one-time injection of an ISCO agent such as sodium persulfate. The ISCO injections will be accomplished using 4 direct push technology (DPT) points surrounding each well location. Confirmation of treatment will be accomplished by performance sampling of new monitoring wells installed at the three treatment locations, with groundwater samples collected quarterly for two years and analyzed for the appropriate parameters (PAHs, VOCs, or PCBs). No groundwater monitoring is anticipated to be required after two years.

### **Institutional Controls**

Institutional controls will be necessary for this alternative because contamination above residential standards will remain in place after remediation is completed. Excavation of surface and subsurface soils to industrial standards means that soils above residential standards will remain at the site. Specifically, a record will need to be added to the property deed by the land owner/developer to note that chemical contamination has been left in place at the site. Additionally, fencing will need to be maintained around the site to exclude access by unauthorized personnel, in order to protect the landowner from potential liability of persons coming into contact with the surface soils that are contaminated. In this alternative, groundwater contaminated above residential standards will also remain at the site. Therefore, the property deed will also need to be modified to contain a restriction that groundwater wells cannot be constructed for recovery and use of groundwater from the surficial aquifer. Also, soils identified for disposal created by any construction or other soil intrusive activities on the site must be disposed at a landfill that can accept soils contaminated with hazardous chemicals at low levels. This process will need to be enforced by the site manager, property manager, or owner.

## **Evaluation**

This alternative is expected to be a moderately protective alternative, since a smaller amount of soil will be removed as compared to Alternative 4. There will be some risk that pre-excavation sampling to refine areas of surface soil may miss areas of contamination between the grid locations sampled in the Phase II ESA. This alternative is expected to be technically feasible to implement, and is also expected to be reliable in controlling site soil and groundwater contamination. There is some risk remaining with implementation of this alternative related to lack of knowledge of the groundwater flow direction and lack of complete lateral definition of low concentration contaminant plumes at the site.

### **3.3.4 Alternative 4 – Complete Soil Excavation and In Situ Groundwater Treatment**

This alternative includes excavation of all surface soils contaminated with PAHs, TPH, PCBs, arsenic and lead, limited excavation in the immediate area of each subsurface soil boring that exhibits contamination above the cleanup criteria, and in situ treatment of contaminated groundwater. Table 3-5 provides a summary of the costs for this alternative. Cost details are presented in Appendix B.

**Table 3-5  
Alternative 4 Cost Breakdown**

<b>Item</b>	<b>Cost</b>
<b>Capital Cost</b>	
Surface Soil Remediation	\$2,022,344
Subsurface Soil Remediation	\$141,433
Groundwater Remediation	\$88,316
<b>Capital Cost Subtotal</b>	<b>\$2,252,093</b>
<b>Operations and Maintenance Cost</b>	
Groundwater Monitoring	\$53,405
<b>Total Cost</b>	<b>\$2,305,497</b>

## **Surface Soils**

For this alternative, all surface soils identified in the Phase II ESA as having contamination present above the cleanup levels will be excavated and disposed off-site. With regards to arsenic, only those surface soils locations with arsenic detected above the maximum background concentration of 32 mg/kg will be included in the excavation extent. Estimation of the lateral extent of surface soils to be excavated is based solely upon surface soil sampling locations on a grid with nominal spacing of 115 feet, as presented in the Phase II ESA report. Table 3-6 presents the specific locations to be included in the excavation extent. The identified area of contaminated surface soils will be excavated to a depth of 1.0 foot. These soils will be excavated across the site by conventional means, including inside much of the Evans Building Complex, and disposed at a landfill that accepts contaminated non-hazardous soils in the local area. A significant

portion of the flooring in the Evans Building Complex is reportedly wood brick, while in the remainder of interior areas it is assumed to be concrete. These materials will be demolished and removed to access the contaminated surface soils. Confirmation sampling of the floor of the excavation will be performed at a rate of one sample per every 5,000 ft<sup>2</sup>. Each confirmation sample will be analyzed for either PAHs, TPH, PCBs, and/or metals according to the contamination present in that particular area as defined by the Phase II analytical results. The exterior excavated areas will be backfilled with clean soil, while the Evans Building Complex areas will not be backfilled, but rather left for TDA to construct a building slab as desired for future building use.

**Table 3-6**  
**Surface Soil Sampling Locations to be Included in**  
**Surface Soils Excavation**

Exterior Areas	Fintube Building Complex	Evans Building Complex
SSA01, SB02, SSA03, SB06, SSB05, SSB08, SSC01, SSC03, SSC05, SSC12, SB04, SB01, SSD07, SSD15, SSE06, SSE07, SB05, SSE11, SSE16	SSD04, SSD05	SSC14, SSD10, SSD11, SSD12, SSD13, SSD14, SSE12, SSE13, SSE14, SSF14

### **Subsurface Soils**

For this alternative, contaminated soils in the immediate vicinity of soil borings SB01 and SB04 will be excavated down to the water table and disposed off-site. Soils will be excavated laterally to 20 feet away from each of these soil borings. The water table is present at approximately 4 feet bgs at SB01 and at approximately 3 feet bgs at SB04. In the case of both of these soil borings, the contaminated soil sample was retrieved from below the apparent water table, however soil excavations to the water table will still be performed under the supposition that the entire soil column is contaminated due to an original release occurring at the surface. The contaminated saturated soils will be addressed by in situ treatment of the groundwater described below. Confirmation sampling of the limits of the excavation will be accomplished with one floor sample and one sample from each excavation sidewall; confirmation soil samples associated with the SB01 excavation will be analyzed for PAHs while samples associated with the SB04 excavation will be analyzed for PCBs. Each of these excavations will be backfilled with clean soils.

### **Groundwater**

The monitoring wells used for retrieval of groundwater samples in the Phase II investigation were temporary wells that were not developed at time of installation, nor purged at time of sampling. As well, whether the groundwater samples collected for metals analysis were filtered at the analytical laboratory has not yet been verified. Therefore, the detection of numerous metals above regional screening levels at SB01, SB02, and SB09 may be attributed to metals adsorbed to soil particulate surfaces. Therefore, management of groundwater will include installation of six new permanent

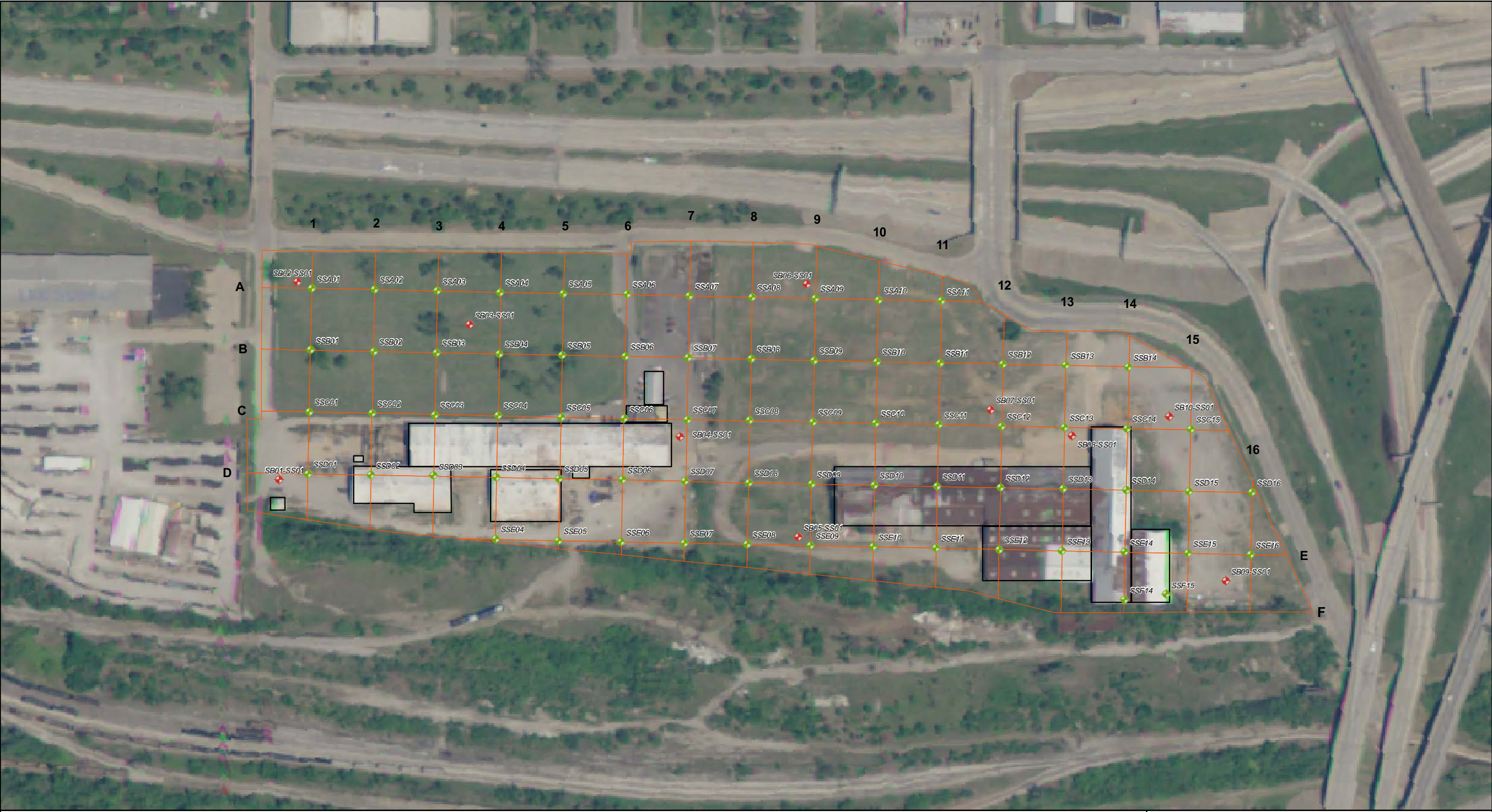
monitoring wells at the locations SB01, SB02, SB04, SB05, SB06, and SB09, development and sampling of these wells with filtration for the samples going to metals analysis. This approach may result in metals analytical results that indicate no exceedances of the respective cleanup levels for metals in groundwater. Additionally, this alternative includes in situ spot treatment of VOC contamination in groundwater at locations SB01 (treat PAHs identified by soil sample), and SB04 (1,2,4-trichlorobenzene). This treatment will utilize ISCO to quickly degrade VOC contamination, and will be implemented by a one-time injection of an ISCO agent such as sodium persulfate. The ISCO injections will be accomplished using 4 DPT points surrounding each well location. Confirmation of treatment will be accomplished by performance sampling of new monitoring wells installed at the three treatment locations, with groundwater samples collected quarterly for two years and analyzed for the appropriate parameters (PAHs, VOCs, or PCBs). No groundwater monitoring is anticipated to be required after two years.

### **Institutional Controls**

Institutional controls will be necessary for this alternative because contamination above residential standards will remain in place after remediation is completed. Excavation of surface and subsurface soils to industrial standards means that soils above residential standards will remain at the site. Specifically, a record will need to be added to the property deed by the land owner/developer to note that chemical contamination has been left in place at the site. Additionally, fencing will need to be maintained around the site to exclude access by unauthorized personnel, in order to protect the landowner from potential liability of persons coming into contact with the surface soils that are contaminated. In this alternative, contaminated groundwater will also remain at the site. Therefore, the property deed will also need to be modified to contain a restriction that groundwater wells cannot be constructed for recovery and use of groundwater from the surficial aquifer. Also, soils identified for disposal created by any construction or other soil intrusive activities on the site must be disposed at a landfill that can accept soils contaminated with hazardous chemicals at low levels. This process will need to be enforced by the site manager, property manager, or owner.

### **Evaluation**

This alternative is expected to be the most protective alternative, since the greatest amount of soil will be removed as compared to the other alternatives, and the groundwater will also be treated. However, this alternative also has the lowest economic feasibility (high cost to implement) for the same reason. This alternative is expected to be technically feasible to implement, and is also expected to be reliable in controlling site soil and groundwater contamination. There is some risk remaining with implementation of this alternative related to lack of knowledge of the groundwater flow direction and lack of complete lateral definition of low concentration contaminant plumes at the site.



Soil Boring Locations

Grid Surface Soil Sample Locations

Sample Grid

Building Footprint

0

125

250

500

Feet

**Sample Location Map**

Former Fintube TBA Site

SCALE: <b>1:2000</b>	DATE: <b>May 2010</b>	FIGURE NO. <b>Figure 3-1</b>
APPROVED BY: <b>CBM</b>	DRAWN BY: <b>JPV</b>	PROJECT NO. <b>1303.RPT.00</b>

Imagery Source: maps.scgis.com OK\_Aerials\_2008 service

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## **4. RECOMMENDATIONS**

The recommended alternative for asbestos material present at the Fintube site is Alternative 2—Complete Asbestos Abatement. The recommended alternative for LBP present at the Fintube site is Alternative 3—Complete Lead-based Paint Abatement. These alternatives are the most cost-effective alternatives posed for these materials.

The recommended alternative for contaminated soil and groundwater is Alternative 3--Moderate Soil Excavation, Limited In Situ Groundwater Treatment and Metals Background Assessment. This alternative represents a reasonable compromise of cost and treatment of the contaminated media.

The Tulsa Development Agency may be able to reduce the cost for soil excavation in Alternative 3 by negotiating with ODEQ to incorporate asphalt paving as a surface soil cap (engineering control) in place of soil excavation for some of the areas identified for excavation at the Fintube site.

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## **Appendix A**

### **Contaminant Exceedance Tables for Surface Soils, Subsurface Soils, and Groundwater**

**Table 5-1**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SSA01		FIN-SSA02	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	7	J	5	
Benzo(a)pyrene	210	µg/kg	371		ND	

Parameter	Limit	Sample Number	FIN-SSA03		FIN-SSA04	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	12	J	5.8	
Benzo(a)pyrene	210	µg/kg	1220		ND	
Benzo(b)fluoranthene	2100	µg/kg	2500		ND	
Dibenzo(a,h)anthracene	210	µg/kg	475		ND	

Parameter	Limit	Sample Number	FIN-SSA05		FIN-SSA06	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	6.5		4.7	

Parameter	Limit	Sample Number	FIN-SSA07		FIN-SSA08	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	2.8	J	4.9	

Parameter	Limit	Sample Number	FIN-SSA09		FIN-SSA10	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	5.7		3.8	J

Parameter	Limit	Sample Number	FIN-SSA11		FIN-SSB01	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	5.7		5.8	

Parameter	Limit	Sample Number	FIN-SSB02		FIN-SSB03	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	5.6	J	10.5	

Parameter	Limit	Sample Number	FIN-SSB04		FIN-SSB05	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	5.9		4.5	
Benzo(a)pyrene	210	µg/kg	136	J	330	

**Table 5-1 - Continued**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SSB06		FIN-SSB07	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	4.1		4.5	J

Parameter	Limit	Sample Number	FIN-SSB08		FIN-SSB09	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	4.9		3.6	
Benzo(a)pyrene	210	µg/kg	911		ND	
Dibenzo(a,h)anthracene	210	µg/kg	218		ND	

Parameter	Limit	Sample Number	FIN-SSB10		FIN-SSB11	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	3.7		ND	

Parameter	Limit	Sample Number	FIN-SSB12		FIN-SSB13	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	5.7		4.7	

Parameter	Limit	Sample Number	FIN-SSB14		FIN-SSC01	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	2.3		3.7	
Benzo(a)pyrene	210	µg/kg	ND		293	

Parameter	Limit	Sample Number	FIN-SSC02		FIN-SSC03	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	6.4		6	J
Benzo(a)pyrene	210	µg/kg	ND		320	

Parameter	Limit	Sample Number	FIN-SSC04		FIN-SSC05	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	8.3		3.4	
Benzo(a)pyrene	210	µg/kg	ND		543	

Parameter	Limit	Sample Number	FIN-SSC06		FIN-SSC07	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	3.2		ND	

**Table 5-1 - Continued**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SSC08		FIN-SSC09	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	5.1		7.8	

Parameter	Limit	Sample Number	FIN-SSC10		FIN-SSC11	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	6.1		6.5	

Parameter	Limit	Sample Number	FIN-SSC12		FIN-SSC13	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1248	740	µg/kg	1160		ND	
Arsenic	1.6	mg/kg	5.7		4.1	
Benzo(a)pyrene	210	µg/kg	532		ND	

Parameter	Limit	Sample Number	FIN-SSC14		FIN-SSC15	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	7890		ND	
Arsenic	1.6	mg/kg	4.2		11.5	
Lead	800	mg/kg	832		61.3	

Parameter	Limit	Sample Number	FIN-SSD01		FIN-SSD02	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	4.9		3	J

Parameter	Limit	Sample Number	FIN-SSD03		FIN-SSD04	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	1400		38100	J
TPH (>C28-C35)	5000*	mg/kg	2010		39500	
Aroclor 1260	740	µg/kg	141	J	767	J
Arsenic	1.6	mg/kg	11.5		ND	

Parameter	Limit	Sample Number	FIN-SSD05		FIN-SSD06	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	44200		181	
Aroclor 1260	740	µg/kg	16400		ND	
Arsenic	1.6	mg/kg	4.1		6.3	

**Table 5-1 - Continued**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SSD07		FIN-SSD08	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	759		100	J
Arsenic	1.6	mg/kg	6.9		3.8	

Parameter	Limit	Sample Number	FIN-SSD09		FIN-SSD10	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	ND		11000	
TPH (>C28-C35)	5000*	mg/kg	ND		12800	
Aroclor 1260	740	µg/kg	222		1640	
Arsenic	1.6	mg/kg	4		19.7	
Lead	800	mg/kg	95.9		2560	
Benzo(a)anthracene	2100	µg/kg	ND		2130	J
Benzo(a)pyrene	210	µg/kg	ND		4270	
Benzo(b)fluoranthene	2100	µg/kg	ND		9480	
Dibenzo(a,h)anthracene	210	µg/kg	ND		1690	J
Indeno(1,2,3-cd)pyrene	2100	µg/kg	ND		7570	

Parameter	Limit	Sample Number	FIN-SSD11		FIN-SSD12	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	33500		34200	
TPH (>C28-C35)	5000*	mg/kg	22000		17800	
Aroclor 1254	740	µg/kg	ND		18000	J
Aroclor 1260	740	µg/kg	929		6250	
Arsenic	1.6	mg/kg	14.3		7.8	
Lead	800	mg/kg	4310		351	

Parameter	Limit	Sample Number	FIN-SSD13		FIN-SSD14	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	7890		3380	
TPH (>C28-C35)	5000*	mg/kg	8920		3510	
Aroclor 1260	740	µg/kg	662		1810	
Arsenic	1.6	mg/kg	7.8		9.8	
Lead	800	mg/kg	153		1700	

**Table 5-1 - Continued**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SSD15		FIN-SSD16	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	70		6.7	
Lead	800	mg/kg	1180		77.5	

Parameter	Limit	Sample Number	FIN-SSE04		FIN-SSE05	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	6.3		14.3	

Parameter	Limit	Sample Number	FIN-SSE06		FIN-SSE07	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	11.6		34.5	
Benzo(a)pyrene	210	µg/kg	721		ND	
Dibenzo(a,h)anthracene	210	µg/kg	346		ND	

Parameter	Limit	Sample Number	FIN-SSE08		FIN-SSE09	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	6.1		5.5	

Parameter	Limit	Sample Number	FIN-SSE10		FIN-SSE11	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	7.6		16.8	
Benzo(a)pyrene	210	µg/kg	ND		255	

Parameter	Limit	Sample Number	FIN-SSE12		FIN-SSE13	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	2050		2370	
Aroclor 1260	740	µg/kg	2080		2070	
Arsenic	1.6	mg/kg	5.5		7.2	

Parameter	Limit	Sample Number	FIN-SSE14		FIN-SSE15	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	7790		ND	
TPH (>C28-C35)	5000*	mg/kg	8270		ND	
Arsenic	1.6	mg/kg	3.9		13.9	

**Table 5-1 - Continued**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SSE16		FIN-SSF14	
		Units	Detection	DVQ	Detection	DVQ
TPH (>C12-C28)	2500*	mg/kg	108		7260	
TPH (>C28-C35)	5000*	mg/kg	127		7100	
Aroclor 1260	740	µg/kg	ND		1220	
Arsenic	1.6	mg/kg	4.8		11.8	
Benzo(a)pyrene	210	µg/kg	1060		ND	

Parameter	Limit	Sample Number	FIN-SSF15		FIN-SB01-SS01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	480		117	
Arsenic	1.6	mg/kg	8.1		6.4	
Benzo(a)pyrene	210	µg/kg	ND		463	

Parameter	Limit	Sample Number	FIN-SB02-SS01-01		FIN-SB03-SS01-01	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	9.8		4.9	
Benzo(a)pyrene	210	µg/kg	1040		164	J

Parameter	Limit	Sample Number	FIN-SB04-SS01-01		FIN-SB05-SS01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	1270		ND	
Arsenic	1.6	mg/kg	9.1		43.8	
Benzo(a)pyrene	210	µg/kg	ND		1190	
Dibenzo(a,h)anthracene	210	µg/kg	ND		217	

Parameter	Limit	Sample Number	FIN-SB06-SS01-01		FIN-SB07-SS01-01	
		Units	Detection	DVQ	Detection	DVQ
Arsenic	1.6	mg/kg	6		6.3	
Benzo(a)pyrene	210	µg/kg	480		ND	

**Table 5-1 - Continued**  
**Surface Soil Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SB08-SS01-01		FIN-SB09-SS01-01	
		Units	Detection	DVQ	Detection	DVQ
<b>Arsenic</b>	1.6	mg/kg	<b>4</b>		<b>4.4</b>	

Parameter	Limit	Sample Number	FIN-SB10-SS01-01	
		Units	Detection	DVQ
<b>Arsenic</b>	1.6	mg/kg	<b>9.1</b>	

Notes and Abbreviations:

Source: U.S. Environmental Protection Agency Regional, Industrial Soil Screening Levels, Ver. 2009

\* ODEQ Regulatory Limit

**Bolded** and yellow shaded area exceed screening levels

J - Estimated Values

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

DVQ- Validation qualifier assigned by project chemist - reason code definitions provided in the validation reports

### 5.1.2 Subsurface Soil Samples from Borings

A total of thirteen (13) subsurface soil samples were collected from the ten (10) soil borings. This total includes ten (10) normal samples, one (1) duplicate, one (1) matrix spike, and one (1) matrix spike duplicate.

The following VOCs were detected in the subsurface soil samples above their MDLs: 2-methylnaphthalene (SB02 and SB06), 1,2,4-trichlorobenzene (SB04), benzene (SB04), and chlorobenzene (SB04). None of the VOC detections were above their RSLs in the subsurface soil samples.

The only subsurface soil sample which contained SVOCs above their MDLs was SB01. Benzo(a)pyrene was detected at a concentration of 1,250 µg/kg which exceeds its RSL of 210 µg/kg. Benzo(b)fluoranthene was detected at a concentration of 4,980 µg/kg which exceeds its RSL of 2,100 µg/kg. Dibenzo(a,h)anthracene was detected at a concentration of 515 µg/kg which exceeds its RSL of 210 µg/kg.

**Table 5-2**  
**Subsurface Soil Samples Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SB01-DS01-01		FIN-SB02-DS01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	218		ND	
Arsenic	1.6	mg/kg	2.4		9.6	
Benzo(a)pyrene	210	µg/kg	1250		ND	
Benzo(b)fluoranthene	2100	µg/kg	4980		ND	
Dibenzo(a,h)anthracene	210	µg/kg	515		ND	

Parameter	Limit	Sample Number	FIN-SB03-DS01-01		FIN-SB04-DS01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	ND		124000	
Arsenic	1.6	mg/kg	14		13.3	
Benzo(a)pyrene	210	µg/kg	ND		ND	
Benzo(b)fluoranthene	2100	µg/kg	ND		ND	
Dibenzo(a,h)anthracene	210	µg/kg	ND		ND	

Parameter	Limit	Sample Number	FIN-SB05-DS01-01		FIN-SB06-DS01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	ND		ND	
Arsenic	1.6	mg/kg	8.3		30.3	
Benzo(a)pyrene	210	µg/kg	ND		ND	
Benzo(b)fluoranthene	2100	µg/kg	ND		ND	
Dibenzo(a,h)anthracene	210	µg/kg	ND		ND	

Parameter	Limit	Sample Number	FIN-SB07-DS01-01		FIN-SB08-DS01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	740	µg/kg	ND		ND	
Arsenic	1.6	mg/kg	18.7		12.1	
Benzo(a)pyrene	210	µg/kg	ND		ND	
Benzo(b)fluoranthene	2100	µg/kg	ND		ND	
Dibenzo(a,h)anthracene	210	µg/kg	ND		ND	

**Table 5-2 - Continued**  
**Subsurface Soil Samples Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SB09-DS01-01		FIN-SB10-DS01-01	
		Units	Detection	DVQ	Detection	DVQ
<b>Aroclor 1260</b>	740	µg/kg	ND		ND	
<b>Arsenic</b>	1.6	mg/kg	<b>23.7</b>		<b>6.8</b>	
<b>Benzo(a)pyrene</b>	210	µg/kg	ND		ND	
<b>Benzo(b)fluoranthene</b>	2100	µg/kg	ND		ND	
<b>Dibenzo(a,h)anthracene</b>	210	µg/kg	ND		ND	

Notes and Abbreviations:

Source: U.S. Environmental Protection Agency Regional, Industrial Soil Screening Levels, Ver. 2009

**Bolded** and yellow shaded area exceed screening levels

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

DVQ- Validation qualifier assigned by project chemist - reason code definitions provided in the validation reports

## 5.2 Groundwater Analytical Results

A total of thirteen (13) groundwater samples were collected from soil borings throughout the Site. The total number of samples includes ten (10) normal samples, one (1) QC duplicate sample, one (1) MS sample, and one (1) MSD sample. The analytical results were screened against the USEPA MCLs or USEPA RSLs for Residential Tap Water (USEPA 2010) when MCLs were not available. The ODEQ risk-based screening level of 1.0 mg/L for GRO and DRO was used to screen all collected groundwater samples (ODEQ 2009). **Appendix C** includes data tables that list every sample for which at least one constituent was detected above the Method Detection Limit. Complete copies of the analytical results, chain of custody forms, and the data validation report are contained on compact disk in **Appendix D**. **Figure 5-6** depicts the locations of the groundwater exceedances at the Site.

The following VOCs were detected in the groundwater samples above their MDLs: acetone (SB01), chloroform (SB01 and SB10), chlorobenzene (SB04), 1,2-dichlorobenzene (SB04), 1,4-dichlorobenzene (SB04), 1,1-dichloroethane (SB02), cis-1,2-dichloroethylene (SB02), methyl chloride (SB09), 1,2,4-trichlorobenzene (SB04), and trichloroethylene (SB02). The detection of 1,2,4-trichlorobenzene in sample SB04 (846 µg/L) exceeded its RSL of 70 µg/L. Additionally, the

**Table 5-3**  
**Groundwater Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SB01-GW01-01		FIN-SB02-GW01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	0.034	µg/L	ND		ND	
Arsenic	10	µg/L	533		646	
Beryllium	4	µg/L	34.4		82.9	
Cadmium	5	µg/L	433		49.2	
Chromium	100	µg/L	838		2230	
Copper	1300	µg/L	3860		1970	
Lead	15	µg/L	16000		762	
Mercury	2	µg/L	8.6		0.58	J
Nickel	730**	µg/L	1040		3240	
Thallium	2	µg/L	13.2	J	2.2	J
Zinc	11000**	µg/L	192000		8930	
Naphthalene	0.14	µg/L	ND		2.4	J
Chloroform	0.15**	µg/L	0.77	J	ND	
1,2,4-Trichlorobenzene	70	µg/L	ND		ND	

Parameter	Limit	Sample Number	FIN-SB03-GW01-01		FIN-SB04-GW01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	0.034	µg/L	ND		4.7	
Arsenic	10	µg/L	7.4	J	ND	
Beryllium	4	µg/L	ND		ND	
Cadmium	5	µg/L	ND		ND	
Chromium	100	µg/L	8.4	J	2.5	J
Copper	1300	µg/L	6.4	J	3	J
Lead	15	µg/L	6.1	J	3.4	J
Mercury	2	µg/L	ND		ND	
Nickel	730**	µg/L	15.2	J	5.4	J
Thallium	2	µg/L	0.089	J	0.15	J
Zinc	11000**	µg/L	ND		14.2	J
Naphthalene	0.14	µg/L	ND		ND	
Chloroform	0.15**	µg/L	ND		ND	
1,2,4-Trichlorobenzene	70	µg/L	ND		846	

**Table 5-3 - Continued**  
**Groundwater Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SB05-GW01-01		FIN-SB06-GW01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	0.034	µg/L	ND		ND	
Arsenic	10	µg/L	43.2		37.9	
Beryllium	4	µg/L	4		4.2	
Cadmium	5	µg/L	1.4	J	ND	
Chromium	100	µg/L	71		89.8	
Copper	1300	µg/L	71.6		73.7	
Lead	15	µg/L	123		93.6	
Mercury	2	µg/L	0.2	J	ND	
Nickel	730**	µg/L	101		139	
Thallium	2	µg/L	1.84	J	0.7	J
Zinc	11000**	µg/L	201		200	
Naphthalene	0.14	µg/L	ND		ND	
Chloroform	0.15**	µg/L	ND		ND	
1,2,4-Trichlorobenzene	70	µg/L	ND		ND	

Parameter	Limit	Sample Number	FIN-SB07-GW01-01		FIN-SB08-GW01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	0.034	µg/L	ND		ND	
Arsenic	10	µg/L	1.2	J	ND	
Beryllium	4	µg/L	ND		ND	
Cadmium	5	µg/L	ND		ND	
Chromium	100	µg/L	ND		2.3	J
Copper	1300	µg/L	ND		2.8	J
Lead	15	µg/L	3.3	J	4.3	J
Mercury	2	µg/L	ND		ND	
Nickel	730**	µg/L	2.4	J	19.2	J
Thallium	2	µg/L	ND		ND	
Zinc	11000**	µg/L	9	J	17.8	J
Naphthalene	0.14	µg/L	ND		ND	
Chloroform	0.15**	µg/L	ND		ND	
1,2,4-Trichlorobenzene	70	µg/L	ND		ND	

**Table 5-3 - Continued**  
**Groundwater Analytical Detections Above Applicable Regulatory Limits**  
**Fintube TBA**

Parameter	Limit	Sample Number	FIN-SB09-GW01-01		FIN-SB10-GW01-01	
		Units	Detection	DVQ	Detection	DVQ
Aroclor 1260	0.034	µg/L	ND		ND	
Arsenic	10	µg/L	<b>377</b>		ND	
Beryllium	4	µg/L	<b>17.3</b>		ND	
Cadmium	5	µg/L	<b>5.1</b>	J	1.6	J
Chromium	100	µg/L	<b>366</b>		3	J
Copper	1300	µg/L	423		4.1	J
Lead	15	µg/L	<b>1690</b>		7.3	J
Mercury	2	µg/L	0.85	J	ND	
Nickel	730**	µg/L	633		39.6	J
Thallium	2	µg/L	5.5	J	ND	
Zinc	11000**	µg/L	1020		42.1	
Naphthalene	0.14	µg/L	ND		ND	
Chloroform	0.15**	µg/L	ND		<b>0.67</b>	J
1,2,4-Trichlorobenzene	70	µg/L	ND		ND	

Notes and Abbreviations:

Source: U.S. Environmental Protection Agency, Regional Screening Levels - Water MCL, Ver. 2009

\*\*U.S. Environmental Protection Agency, Regional Screening Levels-Tap water, Ver. 2009

**Bolded** and yellow shaded area exceed screening levels

J - Estimated Values

mg/L - milligrams per kilogram

µg/L - micrograms per kilogram

QVQ Validation qualifier assigned by project chemist - reason code definitions provided in the validation reports

## 5.3 Asbestos Analytical Results

An asbestos inspection was conducted on April 16, 2010, at the Site by a USEPA-accredited and ODOL-licensed asbestos inspector/management planner with Environmental Hazard Control, Inc. During the inspection, twenty-one (21) samples were collected from sixteen (16) homogenous areas from the Fintube Building Complex and nine (9) samples were collected from seven (7) homogenous areas from the Evans Building Complex. The following types of materials were sampled and analyzed for ACM:

- Hard Pack Fittings
- Floor Tile

## **Appendix B**

### **Cost Estimate**

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Summary of Remedial Alternatives**

**Cost Estimate**

Remedial Alternatives	Non-Discounted Cost			
	Capital Cost	O&M Cost	Total Cost	Duration
Alternative 2 - Limited Soil Excavation and Long-term Groundwater Monitoring	\$1,106,425	\$563,605	\$1,670,030	30 years
Alternative 3 - Moderate Soil Excavation, Limited In Situ GW Treatment and Metals Background Assessment	\$1,248,661	\$53,405	\$1,302,066	2 years
Alternative 4 - Complete Soil Excavation and In Situ GW Treatment	\$2,252,093	\$53,405	\$2,305,497	2 years

**General Notes:**

1. The following markups have been applied to Capital Costs: 5% Design, 3% Office Overhead, 10% Field Overhead, and 20% Contingency.
2. The following markups have been applied to Operations and Maintenance Costs: 0% Design, 3% Office Overhead, 5% Field Overhead, and 5% Contingency.

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 2 - Limited Soil Excavation and Long-term Groundwater Monitoring**  
**Cost Estimate**

**Key Parameters and Assumptions:**

Item	Unit	Value	Notes
<b><u>CAPITAL</u></b>			
Excavation Subcontractor Mobilization	ls	\$2,500	Mobilization, project management and demobilization
Subcontractor pre-construction plans	ls	\$3,500	Preparation and submittal of pre-construction plans and deliverables
<b>SURFACE SOIL REMEDIATION</b>			
<b>Concrete Slab Removal and Concrete Recycling</b>			
Hydraulic breaker mobilization	ls	\$3,000	Engr Estimate
Concrete slab volume	cy	1,470	Concrete slabs removal 6" slab thickness
Cost for concrete slab removal and recycling	\$/cy	\$50	Means
<b>Surface Soil Excavation by Standard Excavator</b>			
Contaminated Soil Volume	cy	6200	Contaminated soils excavated to a depth of 1 ft around each exterior location, and subsurface soils at 2 locations.
Excavation, stockpile, and loading costs	\$/cy	\$12	Historical Quote
<b>Surface Soil Disposal (Contaminated Material)</b>			
CY soil below 50 PPM PCBs	CY	6200	
Disposal at American Environment (< 50 PPM PCB)	cy	7,440	Incl 20% soil vol increase upon excavation and stockpiling
CY to Tons	Tons	10,416	
Cost for disposal at Subtitle C Landfill	\$/cy	\$37	Quote from American Environment, assumes 1.4 tons/cy for excav soil which is \$17 tipping Fee/Ton and \$20 Transport Fee/Ton.
<b>Surface Soil Pre-Excavation and Confirmation</b>			
Pre-Excavation Soil Sampling around each exterior location	ea	50	
Lab Sample Cost for Pre Excavation excluding PAH	\$/ ea	\$214	TestAmerica Quote
Floor Excavation Confirmation Sampling	ea	50	
Lab Sample Cost for Floor Excavation excluding PAH	\$/ea	\$214	TestAmerica Quote
Geotechnical Soil Sampling/Analysis	ls	\$1,000	
<b>Surface Soil Excavation Backfill</b>			
Fill Material (backfill for shallow excavation areas)	\$/cy	\$15	Historical Quote
Fill Material Volume	cy	6,200	
<b>SUBSURFACE SOIL REMEDIATION</b>			
<b>Sub Surface Soil Samples</b>			
DPTs installed per day		4	DPTs installed a day
4 DPTs for subsurface soils at SB01 and SB04	ea	8	Total Soil Borings
DPT Rig Daily Cost	\$/Day	\$3,000	Total Cost each day
Total Days		2	Total Days
<b>Subsurface Soil Pre-Excavation Sample</b>			
Pre-Excavation Sub surface soil Sample at SB01	ea	4	
Lab Sample at SB01 for PAH and PCB	\$/ea	\$180	TestAmerica Quote
Pre-Excavation Sub surface Soil Sample at SB04	ea	4	
Lab Sample at SB04 for PAH and PCBs	\$/ea	180	TestAmerica Quote
<b>Subsurface Soil Excavation by Standard Excavator</b>			
Contaminated Soil Volume	cy	141	Contaminated soils excavated to a depth of 1 ft around each exterior location, and subsurface soils at 2 locations.
Excavation, stockpile, and loading costs	\$/cy	\$12	Historical Quote
<b>SubSurface Soil Disposal (Contaminated Material)</b>			
CY soil below 50 PPM PCBs	cy	83	
Disposal at American Environment (< 50 PPM PCB)	cy	100	Incl 20% soil vol increase upon excavation and stockpiling
CY to Tons	Tons	139	
Cost for disposal at Subtitle C Landfill	\$/cy	\$37	Quote from American Environment, assumes 1.4 tons/cy for excav soil which is \$17 tipping Fee/Ton and \$20 Transport Fee/Ton.
CY soil above 50 PPM PCBs	cy	58	
Disposal at Lone Mt. Waynoka OK (>50 PPM PCB)	cy	70	Incl 20% soil vol increase upon excavation and stockpiling
CY to Tons	Tons	97	
Cost for disposal at Landfill accepting PCBs	\$/cy	\$170	Quote from Lone Mt. Landfill assumes 1.4 tons/cy for excav soil which includes \$70 Tipping Fee/Ton and \$100 Transportation Fee/Ton
Confirmation Sub surface soil Sample at SB01	ea	5	
Lab Sample at SB01 for PAH (SVOC)	\$/ea	\$120	TestAmerica Quote
Confirmation Sub surface Soil Sample at SB04	ea	5	
Lab Sample at SB04 for PCBs	\$/ea	60	TestAmerica Quote
<b>Subsurface Soil Excavation Backfill</b>			
Fill Material (backfill for shallow excavation areas)	\$/cy	\$15	Historical Quote
Fill Material Volume	cy	141	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 2 - Limited Soil Excavation and Long-term Groundwater Monitoring**  
**Cost Estimate**

**Key Parameters and Assumptions:**

Item	Unit	Value	Notes
<u>CAPITAL</u>			
<b>GROUNDWATER REMEDIATION</b>			
<b>Install Monitoring Wells</b>			
Install Monitoring Wells SB01, SB02, SB04, SB05, SB06, SB09	ea	6	Assume 2 monitoring wells @ 15' bgs with 5' screen
Install Monitoring Wells	\$/ea	\$736	
Geologist for Well Installation Oversight	hrs	24	
Geologist Labor Cost	\$/hr	\$80	
<b>Construction Completion Report</b>			
Report	hrs	400	Assume 400 hours to generate construction completion report.
Report	\$/hr	\$80	
<u>O&amp;M</u>			
<b>Quarterly Groundwater Sampling and Analysis (year 1-30)</b>			
Sampling Labor	year	30	Includes 1 days for sampling 6 site wells. Sample all wells for VOCs, metals, PAH
	days/year	1.0	
Sampling Labor	hrs/year	20	Assume 2 sampling technicians at 10 hours/day.
Sampling Labor	\$/hr	\$55	
Analytical Cost	\$/year	\$1,494	Analyze groundwater samples from 6 wells for VOCs (6 @ \$7), Metals (6 @ \$54), and PAH (6 @ \$84). Includes QA/QC.
<b>Sampling and Analysis Report</b>			
Annual Report	years	30	Assume 160 hours to generate annual report.
Annual Report	hrs	160	
Annual Report	\$/hr	\$80	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 2 - Limited Soil Excavation and Long-term Groundwater Monitoring**  
**Cost Estimate**

**CAPITAL COST**

**\$1,106,425**

Activity (unit)	Quantity	Unit Cost	Total	
Excavation Subcontractor Mobilization	1	\$2,500	\$2,500	
Subcontractor pre-construction plans	1	\$3,500	\$3,500	
<b>SURFACE SOIL REMEDIATION</b>				
<b>Concrete Slab Removal and Concrete Recycling</b>				
Hydraulic breaker mobilization	1	\$3,000	\$3,000	
Concrete removal and recycling (cy)	1,470	\$50	\$73,500	
<b>Surface Soil Removal by Standard Excavator</b>				<b>Surface Soil Remediation Subtotal</b>
Soil Excavation (cy)	6,200	\$12	\$74,400	\$660,296
<b>Surface Soil Disposal</b>				<b>Loading Factor</b>
Transport and Disposal				1.5104
Subtitle C Waste Landfill (cy)	10,416	\$37	\$387,996	<b>Surface Soil Remediation Loaded</b>
<b>Surface Soil Pre-Excavation and Confirmation Samples</b>				\$997,311.08
Collect Pre-excavation Soil Samples	50	\$214	\$10,700	
Collect Floor Excavation Soil Samples	50	\$214	\$10,700	
Geotechnical Soil Sampling/Analysis	1	\$1,000	\$1,000	
<b>Surface Soil Excavation Backfill and Site Restoration</b>				
Fill Material for shallow excavation area (cy)	6,200	\$15	\$93,000	
<b>SUBSURFACE SOIL REMEDIATION</b>				<b>Subsurface Soil Remediation Subtotal</b>
<b>Sub Surface Soil Samples</b>				\$33,905.94
DPT rig daily cost	2	\$3,000	\$6,000	
<b>Subsurface Soil Pre-Excavation Sample</b>				<b>Loading Factor</b>
Pre-Excavation Lab Sample at SB01 for PAH (SVOC)	4	\$180	\$720	1.5104
Pre-Excavation Lab Sample at SB04 for PCBs	4	\$180	\$720	
<b>SubSurface Soil Removal by Standard Extractor</b>				<b>Subsurface Soil Remediation Loaded</b>
SubSurface Soil Excavation (cy)	141	\$12	\$1,692	\$51,211.53
<b>SubSurface Soil Disposal</b>				
Transport and Disposal				
Cost of Disposal at American Environment (< 50 PPM PCB)	139	\$37	\$5,194	
Cost for disposal at Landfill accepting PCBs	97	\$170	\$16,565	
<b>Confirmation Subsurface Soil Lab Sample</b>				
Confirmation Lab Sample at SB01 for PAH	5	\$120	\$600	
Confirmation Lab Sample at SB04 for PCBs	5	\$60	\$300	
<b>Subsurface Soil Excavation Backfill and Site Restoration</b>				
Fill Material for shallow excavation area (cy)	141	\$15	\$2,115	
<b>GROUNDWATER REMEDIATION</b>				<b>Groundwater Remediation Subtotal</b>
<b>Install Monitoring Wells</b>				\$38,336
Install Monitoring Wells	6	\$736	\$4,416	
Geologist Well Installation (hrs)	24	\$80	\$1,920	<b>Loading Factor</b>
<b>Construction Completion Report</b>				1.5104
Report	1	\$32,000	\$32,000	<b>Groundwater Remediation Loaded</b>
<b>Subtotal</b>			<b>\$732,538</b>	\$57,902.69
Design		5%	\$36,627	
Office Overhead		3%	\$21,976	
Field Overhead		10%	\$73,254	
<b>Subtotal</b>			<b>\$864,395</b>	
Profit		8%	\$69,152	
Contingency		20%	\$172,879	\$1,106,425.30
<b>Total</b>			<b>\$1,106,425</b>	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 2 - Limited Soil Excavation and Long-term Groundwater Monitoring**  
**Cost Estimate**

**Operation and Maintenance Cost**

**\$563,605**

Activity (unit)	Quantity (yrs)	Annual Cost	Total Cost	Present Value
<b>Quarterly Groundwater Sampling &amp; Analysis (year 1-30)</b>				
Sampling Labor All Events (hr)	30	\$1,100	\$33,000	\$16,910
Analytical Cost All Events	30	\$1,494	\$44,820	\$22,966
<b>Sampling and Analysis Report</b>	30	\$12,800	\$384,000	\$196,767
<b>Subtotal O&amp;M</b>			<b>\$461,820</b>	<b>\$236,644</b>
Design		0%	\$0	\$0
Office Overhead		3%	\$13,855	\$7,099
Field Overhead		5%	\$23,091	\$11,832
<b>Subtotal</b>			<b>\$498,766</b>	<b>\$255,575</b>
Profit		8%	\$39,901	\$20,446
Contingency		5%	\$24,938	\$12,779
<b>Total</b>			<b>\$563,605</b>	<b>\$288,800</b>

**Total Alternative Capital and O&M Cost (Non Discounted Cost)**

**\$1,670,030**

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 3 - Moderate Soil Excavation, Limited In Situ GW Treatment and Metals Background Assessment**  
**Cost Estimate**

**Key Parameters and Assumptions:**

Item	Unit	Value	Notes
<b><u>CAPITAL</u></b>			
Excavation Subcontractor Mobilization	ls	\$2,500	Mobilization, project management and demobilization
Subcontractor pre-construction plans	ls	\$3,500	Preparation and submittal of pre-construction plans and deliverables
<b>SURFACE SOIL REMEDIATION</b>			
<b>Concrete Slab Removal and Concrete Recycling</b>			
Hydraulic breaker mobilization	ls	\$3,000	Engr Estimate
Concrete slab volume	cy	1,470	Concrete slabs removal 6" slab thickness
Cost for concrete slab removal and recycling	\$/cy	\$50	Means
<b>Surface Soil Excavation by Standard Excavator</b>			
Contaminated Soil Volume	cy	6900	Contaminated soils
Excavation, stockpile, and loading costs	\$/cy	\$12	Historic Quote
<b>Surface Soil Disposal (Contaminated Material)</b>			
CY soil below 50 PPM PCBs	cy	6900	
Disposal at American Environment (< 50 PPM PCB)	cy	8,280	Incl 20% soil vol increase upon excavation and stockpiling
Cost of Disposal at American Environment (< 50 PPM PCB)	\$/cy	\$37	Quote from American Environment, assumes 1.4 tons/cy for excav soil which is \$17 tipping Fee/Ton and \$20 Transport Fee/Ton.
Cy to Tons	Tons	11,592	
<b>Surface Soil Pre-Excavation and Confirmation</b>			
Pre-Excavation Soil Sampling around each exterior location	ea	50	
Lab Sample Cost for Pre Excavation excluding PAH	\$/ea	\$214	TestAmerica Quote TPH, PCB, Metals
Floor Excavation Confirmation Sampling	ea	70	
Lab Sample Cost for Floor Excavation excluding PAH	\$/ea	\$214	TestAmerica Quote TPH, PCB, Metals
Geotechnical Soil Sampling/Analysis	ls	\$1,000	
<b>Surface Soil Excavation Backfill</b>			
Fill Material (backfill for shallow excavation areas)	\$/cy	\$15	Historical Quote
Fill Material Volume	cy	6,900	
<b>SUBSURFACE SOIL REMEDIATION</b>			
<b>Sub Surface Soil Samples</b>			
DPTs operated each day		4	4 DPT installed a day
4 DPTs for subsurface soils at SB01 and SB04	ea	8	Total Soil Borings
Install Cost	\$/Day	\$3,000	Total Cost each day
Total Days		2	Total Days
<b>Subsurface Soil Pre-Excavation Sample</b>			
Pre-Excavation Sub surface soil Sample at SB01	ea	4	
Lab Sample at SB01 for PAH (SVOC) and PCB	\$/ea	\$180	TestAmerica Quote
Pre-Excavation Sub surface Soil Sample at SB04	ea	4	
Lab Sample at SB04 for PAH and PCBs	\$/ea	180	TestAmerica Quote
<b>SubSurface Soil Excavation by Standard Excavator</b>			
Contaminated Soil Volume	cy	141	Contaminated soils
Excavation, stockpile, and loading costs	\$/cy	\$12	Historic Quote
<b>SubSurface Soil Disposal (Contaminated Material)</b>			
CY soil below 50 PPM PCBs	cy	83	
Disposal at American Environment (< 50 PPM PCB)	cy	100	Incl 20% soil vol increase upon excavation and stockpiling
Cost of Disposal at American Environment (< 50 PPM PCB)	\$/cy	\$37	Quote from American Environment, assumes 1.4 tons/cy for excav soil which is \$17 tipping Fee/Ton and \$20 Transport Fee/Ton.
Cy to Tons	Tons	139	
Disposal at Lone Mt. Waynoka OK (>50 PPM PCB)	cy	58	Incl 20% soil vol increase upon excavation and stockpiling
Cy to Tons	Tons	81	
Cost for disposal at Landfill accepting PCBs	\$/cy	\$170	Quote from Lone Mt. Landfill assumes 1.4 tons/cy for excav soil which includes \$70 Tipping Fee/Ton and \$100 Transportation Fee/Ton
Confirmation Sub surface soil Sample at SB01	ea	5	
Lab Sample at SB01 for PAH (SVOC)	\$/ea	\$120	TestAmerica Quote
Confirmation Sub surface Soil Sample at SB04	ea	5	
Lab Sample at SB04 for PCBs	\$/ea	60	TestAmerica Quote
<b>Subsurface Soil Excavation Backfill</b>			
Fill Material (backfill for shallow excavation areas)	\$/cy	\$15	Historical Quote
Fill Material Volume	cy	141	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 3 - Moderate Soil Excavation, Limited In Situ GW Treatment and Metals Background Assessment**  
**Cost Estimate**

**Key Parameters and Assumptions:**

Item	Unit	Value	Notes
<b><u>CAPITAL</u></b>			
<b>GROUNDWATER REMEDIATION</b>			
<b>Install Monitoring Wells</b>			
Install Monitoring Wells SB01, SB02, SB04, SB05, SB06, SB09	ea	6	Assume 2 monitoring wells @ 15' bgs with 5' screen
Install Monitoring Wells	\$/ea	\$736	Assume 1" casing, 5' prepack screen, 5" well mount
Geologist for Well Installation Oversight	hrs	16	
Geologist Labor Cost	\$/hr	\$80	
DPT Installed Per Day	day	2	4 DPT installed a day
DPT Rig Daily Cost	\$/day	\$3,000	Based upon historic costs
ISCO	lbs	2,334	Sodium Persulfate
ISCO cost	\$/lb	\$1.08	Historical Information
Activator	lbs	4,667	Hydrogen Peroxide
Activator Cost	\$/lb	\$1.00	Historical Information
Pumps, piping, tanks, mixers, misc.	ls	3,334	Historical Information
Field Technicians for ISCO Injection	hrs	80	Estimate based on experience, 2 Technicians
Field Technician Labor Cost	\$/hr	\$55	
<b>Background Metals Sample</b>			
Confirmaiton Groundwater Sample for Metals at SB01, SB02, SB04, SB05, SB06, SB09	ea	6	
Lab Sample at SB01, SB02, SB04, SB05, SB06, SB09 for Metals	\$/ea	\$54	
Sampling Labor	year	2	
Sampling Labor	days	4	
Sampling Labor	hours	80	
Sampling Labor Cost	\$/hr	\$55	
<b>Construction Completion Report</b>			
Report	hrs	400	Assume 400 hours to generate construction completion report.
Report	\$/hr	\$80	
<b><u>O&amp;M</u></b>			
<b>Quarterly Groundwater Sampling and Analysis (year 1-2)</b>			
Sampling Labor	year	2	
	days/year	4.0	Includes 1 days for sampling 6 site wells per event. Sample all wells for VOCs, PAHs, PCBS. Four quarterly events.
Sampling Labor	hrs/year	80	Assume 2 sampling technicians at 10 hours/day.
Sampling Labor	\$/hr	\$55	
Analytical Cost	\$/year	\$4,680	Analyze groundwater samples from 6 wells for PAH (6@84), VOCs (6@ \$57), and PCBs (6@54). Includes QA/QC.
<b>Sampling and Analysis Report</b>			
Annual Report	years	2	
Annual Report	hrs	160	Assume 160 hours to generate annual report.
Annual Report	\$/hr	\$80	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 3 - Moderate Soil Excavation, Limited In Situ GW Treatment and Metals Background Assessment**  
**Cost Estimate**

**CAPITAL COST**

**\$1,248,661**

Activity (unit)	Quantity	Unit Cost	Total	
Excavation Subcontractor Mobilization	1	\$2,500	\$2,500	
Subcontractor pre-construction plans	1	\$3,500	\$3,500	
<b>SURFACE SOIL REMEDIATION</b>				
<b>Concrete Slab Removal and Concrete Recycling</b>				<b>Surface Soil Remediation Subtotal</b>
Hydraulic breaker mobilization	1	\$3,000	\$3,000	\$727,282
Concrete removal and recycling (cy)	1,470	\$50	\$73,500	
<b>Surface Soil Removal by Standard Excavator</b>				<b>Loading Factor</b>
Soil Excavation (cy)	6,900	\$12	\$82,800	1.5104
<b>Surface Soil Disposal</b>				<b>Surface Soil Remediation Loaded Subtotal</b>
Transport and Disposal				\$1,098,486.73
Cost of Disposal at American Environment (< 50 PPM PCB)	11,592	\$37	\$431,802	
<b>Surface Soil Samples</b>				<b>Subsurface Soil Remediation Subtotal</b>
Collect Pre-excavation Soil Samples	50	\$214	\$10,700	\$31,685
Collect Floor Excavation Soil Samples	70	\$214	\$14,980	
Geotechnical Soil Sampling/Analysis	1s	\$1,000	\$1,000	
<b>Surface Soil Excavation Backfill</b>				<b>Loading Factor</b>
Fill Material for shallow excavation area (cy)	6,900	\$15	\$103,500	1.5104
<b>SUBSURFACE SOIL REMEDIATION</b>				<b>Subsurface Soil Remediation Loaded Subtotal</b>
<b>Sub Surface Soil Samples</b>				\$47,857.24
DPT rig daily cost	2	\$3,000	\$6,000	
<b>Subsurface Soil Pre-Excavation Sample</b>				
Pre-Excavation Lab Sample at SB01 for PAH (SVOC)	4	\$180	\$720	
Pre-Excavation Lab Sample at SB04 for PCBs	4	\$180	\$720	
<b>SubSurface Soil Excavation by Standard Excavator</b>				
Excavation, stockpile, and loading costs	141	\$12	\$1,692	
<b>SubSurface Soil Disposal (Contaminated Material)</b>				
Cost of Disposal at American Environment (< 50 PPM PCB)	139	\$37	\$5,194	
Cost for disposal at Landfill Accepting PCBs	81	\$170	\$13,804	
<b>Subsurface Soil Confirmation Lab Sample</b>				
Confirmation Lab Sample at SB01 for PAH (SVOC)	4	\$180	\$720	
Confirmation Lab Sample at SB04 for PCBs	4	\$180	\$720	
<b>Subsurface Soil Excavation Backfill</b>				
Fill Material for shallow excavation area (cy)	141	\$15	\$2,115	
<b>GROUNDWATER REMEDIATION</b>				<b>Groundwater Remediation Subtotal</b>
<b>Install Monitoring Wells</b>				\$67,742
Install Monitoring Wells	6	\$736	\$4,416	
Geologist Well Installation (hrs)	16	\$80	\$1,280	
DPT Rig Daily Cost	2	\$3,000	\$6,000	
ISCO(lbs)	2,334	\$1.08	\$2,521	<b>Loading Factor</b>
Activator (lbs)	4,667	\$1.00	\$4,667	1.5104
Injection Equipment (ls)	1s	\$3,334	\$3,334	<b>Groundwater Remediation Loaded Subtotal</b>
Field Technicians Injection (hrs)	80	\$55	\$4,400	\$102,317.09
<b>Background Metals Smampling</b>				
Lab Sample at SB01, SB02, SB04, SB05, SB06, SB09	6	\$54	\$324	
Annual Sampling Labor	2	\$4,400	\$8,800	
<b>Construction Completion Report</b>				
Report	1	\$32,000	\$32,000	
<b>Subtotal</b>			\$826,709	
Design		5%	\$41,335	
Office Overhead		3%	\$24,801	
Field Overhead		10%	\$82,671	
<b>Subtotal</b>			\$975,516	
Profit		8%	\$78,041	\$1,248,661.06
Contingency		20%	\$195,103	
<b>Total</b>			\$1,248,661	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 3 - Moderate Soil Excavation, Limited In Situ GW Treatment and Metals Background Assessment**  
**Cost Estimate**

**Operation and Maintenance Cost**

**\$53,405**

Activity (unit)	Quantity (yrs)	Annual Cost	Total Cost	Present Value
<b>Quarterly Groundwater Sampling &amp; Analysis (year 1-2)</b>				
Sampling Labor All Events (hr)	2	\$4,400	\$8,800	\$8,181
Analytical Cost All Events	2	\$4,680	\$9,360	\$8,702
<b>Sampling and Analysis Report</b>	2	\$12,800	\$25,600	\$23,800
<b>Subtotal O&amp;M</b>			\$43,760	\$40,684
Design		0%	\$0	\$0
Office Overhead		3%	\$1,313	\$1,221
Field Overhead		5%	\$2,188	\$2,034
<b>Subtotal</b>			\$47,261	\$43,939
Profit		8%	\$3,781	\$3,515
Contingency		5%	\$2,363	\$2,197
<b>Total</b>			<b>\$53,405</b>	<b>\$49,651</b>

**Total Alternative Capital and O&M Cost (Non Discounted Cost)**

**\$1,302,066**

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 4 - Complete Soil Excavation and In Situ GW Treatment**  
**Cost Estimate**

Item	Unit	Value	Notes
<b><u>CAPITAL</u></b>			
Excavation Subcontractor Mobilization	ls	\$2,500	Mobilization, project management and demobilization
Subcontractor pre-construction plans	ls	\$3,500	Preparation and submittal of pre-construction plans and deliverables
<b>SURFACE SOIL REMEDIATION</b>			
<b>Concrete Slab Removal and Concrete Recycling</b>			
Hydraulic breaker mobilization	ls	\$3,000	Engr Estimate
Concrete slab volume	cy	1,470	Concrete slabs removal 6" slab thickness
Cost for concrete slab removal and recycling	\$/cy	\$50	Means
<b>Surface Soil Excavation with a Standard Excavator</b>			
Contaminated Soil Volume	cy	14700	Contaminanted soils
Excavation, stockpile, and loading costs	\$/cy	\$12	Historic Quote
<b>Soil Disposal (Contaminated Material)</b>			
Disposal at American Environment (< 50 PPM PCB)	cy	17,640	Incl 20% soil vol increase upon excavation and stockpiling
Cy to Tons	Tons	24,696	
Cost for disposal at Subtitle C Landfill	\$/ton	\$37	Quote from American Environment, assumes 1.4 tons/cy for excav soil which is \$17 tipping Fee/Ton and \$20 Transport Fee/Ton.
<b>Surface Soil Confirmation Samples</b>			
Confirmation Soil Sampling around each exterior location	ea	80	
Lab Sample Cost for Confirmation Sampling	\$/ ea	\$314	TestAmerica Quote PAH, TPH, PCB, Metals
<b>Surface Soil Backfill</b>			
Fill Material (backfill for shallow excavation areas)	\$/cy	\$15	Historical Quote
Fill Material Volume	cy	9,000	
<b>SUBSURFACE SOIL REMEDIATION</b>			
<b>SubSurface Soil Excavation by Standard Excavator</b>			
Contaminated Soil Volume	cy	500	Contaminanted soils
Excavation, stockpile, and loading costs	\$/cy	\$12	Historic Quote
<b>Subsurface Soil Disposal</b>			
CY soil below 50 PPM PCBs	cy	285	
Disposal at American Environment (< 50 PPM PCB)	cy	342	Incl 20% soil vol increase upon excavation and stockpiling
Cost of Disposal at American Environment (< 50 PPM PCB)	\$/cy	\$37	Quote from American Environment, assumes 1.4 tons/cy for excav soil which is \$17 tipping Fee/Ton and \$20 Transport Fee/Ton.
Cy to Tons	Tons	479	
CY soil above 50 PPM PCBs	cy	215	
Disposal at Lone Mt. Waynoka OK (>50 PPM PCB)	cy	258	Incl 20% soil vol increase upon excavation and stockpiling
Cy to Tons	Tons	361	
Cost for disposal at Hazardous Waste Landfill	\$/cy	\$170	Quote from Lone Mt. Landfill assumes 1.4 tons/cy for excav soil which includes \$70 Tipping Fee/Ton and \$100 Transportation Fee/Ton
<b>Subsurface Soil Confirmation</b>			
Confirmation Sub surface soil Sample at SB01	ea	5	
Lab Sample at SB01 for PAH (SVOC)	\$/ea	\$120	TestAmerica Quote
Confirmation Sub surface Soil Sample at SB04	ea	5	
Lab Sample at SB04 for PCBs	\$/ea	60	TestAmerica Quote
<b>Subsurface Soil Excavation Backfill</b>			
Fill Material (backfill for shallow excavation areas)	\$/cy	\$15	Historical Quote
Fill Material Volume	cy	500	
<b>GROUNDWATER REMEDIATION</b>			
DPT Installed Per Day	day	2	4 DPT installed a day
DPT Daily Rig Cost	\$/day	\$3,000	Based upon historic costs
ISCO	lbs	2,334	Sodium Persulfate
ISCO cost	\$/lb	\$1.08	Historical Information
Activator	lbs	4,667	Hydrogen Peroxide
Activator Cost	\$/lb	\$1.00	Historical Information
Pumps, piping, tanks, mixers, misc.	ls	\$3,334	Historical Information
Field Technicians for ISCO Injection	hrs	66	Estimate based on experience, 2 Technicians
Field Technician Labor Cost	\$/hr	\$55	
<b>Install Groundwater Monitoring Wells</b>			
Install Monitoring Wells at locations SB01, SB02, SB04, SB05, SB06, SB09	ea	6	Assume 2 monitoring wells @ 15' bgs with 5' screen
Install Monitoring Wells	\$/ea	\$736	Assume 1" casing, 5' prepack screen, 5" well mount,
Geologist for Well Installation Oversight	hrs	24	
Geologist Labor Cost	\$/hr	\$80	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 4 - Complete Soil Excavation and In Situ GW Treatment**  
**Cost Estimate**

Item	Unit	Value	Notes
<b><u>CAPITAL</u></b>			
<b>Background Metals Sample</b>			
Confirmaiton Groundwater Sample for Metals at SB01, SB02, SB04, SB05, SB06, SB09	ea	6	
Lab Sample at SB01, SB02, SB04, SB05, SB06, SB09 for Metals	\$/ea	\$54	
Sampling Labor	year	1	
Sampling Labor	days	1	
Sampling Labor	hours	20	
Sampling Labor Cost	\$/hr	\$55	
<b>Construction Completion Report</b>			
Report	hrs	400	Assume 400 hours to generate construction completion report.
Report	\$/hr	\$80	
<b><u>O&amp;M</u></b>			
<b>Quarterly Groundwater Sampling and Analysis (year 1-2)</b>	year	2	
Sampling Labor	days/year	4.0	Includes 1 days for sampling at three treatment locations. Sample all wells for VOCs, PAHs, PCBS. Four quarterly events.
Sampling Labor	hrs/year	80	Assume 2 sampling technicians at 10 hours/day.
Sampling Labor	\$/hr	\$55	
Analytical Cost	\$/year	\$4,680	Analyze groundwater samples from 6 wells for PAH (6@84), VOCs (6@ \$57), and PCBs (6@54). Includes QA/QC.
<b>Sampling and Analysis Report</b>			
Annual Report	year	2	
Annual Report	hrs	160	Assume 160 hours to generate annual report.
Annual Report	\$/hr	\$80	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 4 - Complete Soil Excavation and In Situ GW Treatment**  
**Cost Estimate**

**CAPITAL COST**

**\$2,252,093**

Activity (unit)	Quantity	Unit Cost	Total	
Excavation Subcontractor Mobilization	1	\$2,500	\$2,500	
Subcontractor pre-construction plans	1	\$3,500	\$3,500	
<b>SURFACE SOIL REMEDIATION</b>				
<b>Concrete Slab Removal and Concrete Recycling</b>				<b>Surface Soil Subtotal</b>
Hydraulic breaker mobilization	1	\$3,000	\$3,000	<b>\$1,338,946</b>
Concrete slab volume	1,470	\$50	\$73,500	<b>Loading Factor</b>
<b>Surface Soil Removal</b>				<b>1.51</b>
Soil Excavation (cy)	14700	\$12	\$176,400	<b>Surface Soil Loaded Subtotal</b>
<b>Surface Soil Disposal</b>				<b>\$2,022,344</b>
Transport and Disposal				
Cost of Disposal at American Environment (< 50 PPM PCB)	24,696	\$37	\$919,926	
<b>Surface Soil Confirmation</b>				
Collect Confirmation Soil Samples	80	\$314	\$25,120	
<b>Surface Soil Backfill</b>				
Fill Material for shallow excavation area (cy)	9,000	\$15	\$135,000	
<b>SUBSURFACE SOIL REMEDIATION</b>				<b>Subsurface Soil Remediation Subtotal</b>
<b>SubSurface Soil Excavation by Standard Excavator</b>				<b>\$93,639</b>
Excavation, stockpile, and loading costs	500	\$12	\$6,000	<b>Loading Factor</b>
<b>SubSurface Soil Disposal (Contaminated Material)</b>				<b>1.51</b>
Cost of Disposal at American Environment (< 50 PPM PCB)	479	\$37	\$17,835	<b>Subsurface Soil Remediation Loaded</b>
Cost for disposal at Landfill accepting PCBs(>50 PPM PCB)	361	\$170	\$61,404	<b>\$141,432.80</b>
<b>Subsurface Soil Confirmation</b>				
Confirmation Lab Sample at SB01 for PAH (SVOC)	5	\$120	\$600	
Confrimaiton Lab Sample at SB04 for PCBs	5	\$60	\$300	
<b>Subsurface Soil Excavation Backfill</b>				
Fill Material for shallow excavation area (cy)	15	\$500	\$7,500	
<b>GROUNDWATER REMEDIATION</b>				<b>Groundwater Remediation Subtotal</b>
DPT Rig Daily Cost	2	\$3,000	\$6,000	<b>\$58,472</b>
ISCO (lbs)	2,334	\$1.08	\$2,521	<b>Loading Factor</b>
Activator (lbs)	4,667	\$1.00	\$4,667	<b>1.51</b>
Injection Equipment (ls)	ls	\$3,334	\$3,334	<b>Groundwater Remediation Loaded</b>
Field Technicians Injection (hrs)	66	\$55	\$3,630	<b>\$88,315.69</b>
<b>Install Groundwater Monitoring Wells</b>				
Install Monitoring Wells	6	\$736	\$4,416	
Geologist Well Installation (hrs)	24	\$20	\$480	
<b>Background Metals Sampling</b>				
Lab Sample at SB01, SB02, SB04, SB05, SB06, SB09	6	\$54	\$324	
Annual Sampling Labor	1	\$1,100.00	\$1,100	
<b>Construction Completion Report</b>				
Report	400	\$80	\$32,000	
<b>Subtotal</b>			<b>\$1,491,057</b>	
Design		5%	\$74,553	
Office Overhead		3%	\$44,732	
Field Overhead		10%	\$149,106	
<b>Subtotal</b>			<b>\$1,759,447</b>	
Profit		8%	\$140,756	
Contingency		20%	\$351,889	<b>\$2,252,092.52</b>
<b>Total</b>			<b>\$2,252,093</b>	

**Remedial Alternatives for Fintube Site, Tulsa, Oklahoma**  
**Alternative 4 - Complete Soil Excavation and In Situ GW Treatment**  
**Cost Estimate**

**Operation and Maintenance Cost**

**\$53,405**

Activity (unit)	Quantity (yrs)	Annual Cost	Total Cost	Present Value
<b>Quarterly Groundwater Sampling &amp; Analysis (year 1-2)</b>				
Sampling Labor All Events (hr)	2	\$4,400	\$8,800	\$8,181
Analytical Cost All Events	2	\$4,680	\$9,360	\$8,702
<b>Sampling and Analysis Report</b>	2	\$12,800	\$25,600	\$23,800
<b>Subtotal O&amp;M</b>			<b>\$43,760</b>	<b>\$40,684</b>
Design		0%	\$0	\$0
Office Overhead		3%	\$1,313	\$1,221
Field Overhead		5%	\$2,188	\$2,034
<b>Subtotal</b>			<b>\$47,261</b>	<b>\$43,939</b>
Profit		8%	\$3,781	\$3,515
Contingency		5%	\$2,363	\$2,197
<b>Total</b>			<b>\$53,405</b>	<b>\$49,651</b>

**Total Alternative Capital and O&M Cost (Non Discounted Cost)**

**\$2,305,497**